CHEMICAL & METALLURGICAL ENGINEERING

VOLUME FORTY-TWO NUMBER THREE

MARCH, 1935

NRA CODE

THIS MONTH

CONTAINERS • First of an unusual series of practical discussions of the problems met in selecting, testing and use of chemical containers Page 132

DISINTEGRATION • A process of partial grinding plus air separation removes impurities from enameler's clay ... Page 154

MATERIALS OF CONSTRUCTION • How salt corrosion has been successfully prevented for many years appears on ... Page 124 • Materials that have been found by experience to be most satisfactory for pump construction in the petroleum refinery are discussed on ... Page 144

PRICING • Do you know the scientific basis for pricing your product? Whether you do or not, see ... Page 139

SULPHURIC ACID • Spangler describes the new process for converting waste ferrous sulphate into strong sulphuric acid ... Page 129

NEXT MONTH

TAKING our cue from American Chemical Industries Tercentenary, we propose to have a look at the historical development of chemical engineering since the days of the alchemists—from Parcelsus to Parmelee, so to speak. We want to show, if we can, how much the improvement in the tools of the profession has contributed to the great industrial advance. Have you any suggestions? Any tips as to where we can unearth interesting historical data or old pictures of plants and equipment? We'll be glad to hear from you!

Published monthly, price 35 cents a copy. Subscription rates—United States, Mexico, and Central and South American countries, $3.00 a year. Canada, including duty, $3.50 a year. All other countries, $5.00 a year or 20 shillings. Entered as second-class matter July 13, 1918, at the Post Office at New York, N. Y., under the Act of March 3, 1879. Printed in U. S. A.

Member A.B.C. Member A.B.P.

McGRAW-HILL PUBLISHING COMPANY, INC.

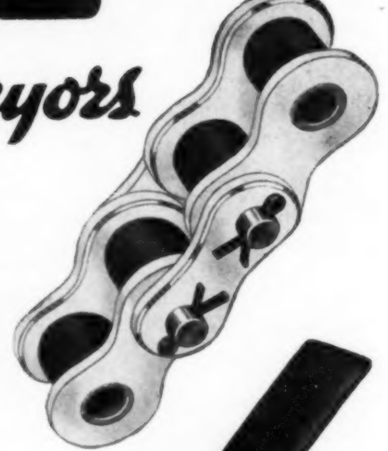
330 W. 42d St., New York, N. Y. Cable Address McGraw-Hill, N. Y.

Branch Offices: 520 North Michigan Ave., Chicago; 883 Mission St., San Francisco; Aldwych House, Aldwych, London, W. C. 2; Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Greenville, S. C. James H. McGraw, Chairman of the Board; Malcolm Muir, President; James H. McGraw, Jr., Vice-President and Treasurer; L. F. Stoll, Vice-President; B. R. Putnam, Secretary.

"Constantly Improved"

LINK-BELT CHAINS

for Drives and Conveyors



ONE of the reasons for the preference accorded Link-Belt Chains and Sprockets is that our research, experimental and laboratory departments are constantly at work to develop increased durability and qualities which result in greater satisfaction to the user. We are never satisfied. Today's durability and performance records are just marks to better.

Specify Link-Belt Chains and Sprockets. This Identifying Trade >—< Mark is assurance that you are getting the genuine Link-Belt product. Send for catalog.

LINK-BELT COMPANY

Leading Manufacturers of Equipment for Handling Materials
Mechanically and Transmitting Power Positively

CHICAGO - PHILADELPHIA - INDIANAPOLIS
ATLANTA - SAN FRANCISCO - TORONTO

Offices in Principal Cities

5170

CHEMICAL & METALLURGICAL ENGINEERING

VOLUME 42 ESTABLISHED 1902 NUMBER 3

McGRAW-HILL PUBLISHING COMPANY, INC

S. D. KIRKPATRICK, Editor

MARCH, 1935

CHEMICAL INDUSTRIES' TERCENTENARY

THOSE INCLINED to be meticulous may quarrel with the contention that what we know today as the American chemical industries had their origin in 1635 in John Winthrop, Jr.'s Connecticut colony. There is room for argument. Certainly we know that Virginia had her first glass plant in 1608, her leather tanneries before 1620, and that pot or soap ashes were made by the Pilgrim Fathers. But, after all, such differences are trivial; the important point is that the great industries that descended from these crude beginnings can now well afford to pay homage to that heroic pioneer who landed in Boston in 1631 at the age of twenty-five and soon became interested in the production of alum, copper, glass, iron, potash, salt, tar, naval stores and other needed goods. Some of the economic and political vicissitudes suffered by young Winthrop in his early competition with Old World industries have their counterparts in our present situation. Perhaps it is time we took stock—not in decades but in centuries—and in so doing it will be well to take the public into our confidence.

It is unfortunately true that at the present time there are several popular misconceptions regarding chemical industry that might conceivably lead to dangerous consequences. First is the general idea that the World War was largely, if not solely, responsible for the development of all of our chemical industries in this country. Reasoning from that premise, we are immediately associated with munitions, with wartime profits, with mushroom growth and with the struggle for tariff protection for the dye and organic chemical industries. Anything that will bring home to the American public the sound and essential basis on which our chemical industries have slowly developed over a period of centuries will help in counteracting the prejudices of those who have been misled by sensational propaganda.

The very fact that all of Winthrop's projects were for peace-time pursuits lays emphasis on the basic character of chemical industry. The industries that first took root in this country and continued to grow even in the face of opposition from abroad were those that supplied the products needed for the logical development of our natural resources. It is not surprising to discover that American industry was not long in reaching a position of actual superiority over its European rivals in those fields in which power and native ingenuity could be applied in large-scale production of heavy chemicals. That was the situation prior to the World War. What developed thereafter was the building on this substantial foundation of the brilliant super-structure that has given us our present diversity of production and achievement.

In Winthrop's day the British government held firmly to the theory that the colonies should produce only raw materials and should depend upon the mother country for all manufactured goods. Today, strangely enough, there are those in our own government who seem to be committed to a somewhat similar theory. They apparently feel that in order to advance our foreign trade, particularly in the export of agricultural materials, we should sacrifice certain of our less important industries. Those most often referred to are the "war-born, tariff-nurtured, so-called 'infant industries' that cannot stand the 'gaff' of world competition." If American Chemical Industries' Tercentenary does nothing more than bring home to the public—and more particularly to the Congress—the long established, basic necessity of chemical industry in this country, it will have been worthwhile.

From an EDITORIAL Viewpoint

Block the Black Bill!

TIME was when we might have been persuaded that something comparable to Senate Bill 87, the Black 30-hour Bill now before the Senate, might prove an ultimate solution to our depression-bred difficulties. We are no longer persuadable. We are fully convinced that it would be difficult, if not impossible, to conceive of more disastrous legislation.

A clearer and more damning indictment of this indefensible proposal has never been offered than that prepared by Messrs. Moulton and Leven, of the Brookings Institution, in their study entitled "The Thirty-Hour Week." It is not our intention to summarize their findings here, but rather to urge that every reader, who has the economic well-being of his country at heart, familiarize himself with what these economists have written.

Lifting ourselves by our bootstraps has been notoriously unsuccessful thus far. Nor has it been explained by the A. F. of L. and its legislative cronies just how we are going to be able to consume more by producing less at higher cost. Labor leaders with an eye to membership totals may be hard put to it to appear indispensable to their present and prospective constituents. But if it is to become a question of choosing between the prosperity of labor leaders and that of the country, *we* choose the country.

Honest Bookkeeping To Be Asked of Government

FACT FACING in the accounting methods of government will be required by federal statute if business groups active in Washington succeed in pressing to enactment the Clark-Shannon bill now before Congress. This measure provides that the bookkeeping system used by Uncle Sam take into account all facts properly affecting cost so that competition with outside business may not proceed on an unwarranted assumption as to the relative dollar efficiency involved.

Judge Grubb of Birmingham has ruled that the Tennessee Valley Authority cannot go into the power-generating and power-distributing business, as this is not within the constitutional rights of the Federal Government. That decision is subject to the review of the higher courts and may or may not stand. But in any event when such an enterprise with government backing enters into an effort of this sort, the first requirement should be that it keep its costs on a basis comparable with those of private enterprise. Then the public can be informed as to the fiscal situation and not be misled by political clamor. T.V.A. has given at least lip service to this principle; and there is no reason to believe that it will not keep its books in a straightforward fashion as time goes on. But it is well that this be a requirement of law, not merely an administrative decision of the Authority.

Delivered Cost The One That Counts

OUR PREDICTION last August that decentralization of industry would be up for active consideration by the present Congress came a step nearer realization this month when the Business Advisory and Planning Council for the Department of Commerce presented its definite recommendations to Secretary Roper. These recommendations include the establishment of a government agency to administer a $2,500,000 revolving fund out of which loans might be made to industries that can operate more advantageously in rural districts than in crowded metropolitan centers. Foreseeing political complications in any competitive bidding between city and country, the Secretary expressed the belief that "decentralization of industry could best be brought about by the building up of branch establishments in the isolated communities." All this is of more than passing interest to chemical industry as is evidenced by the trends of recent years. How far are we to go in this direction? What is the determining factor that dictates industrial migration?

In the opinion of one executive in chemical industry, for whose views we hold the greatest respect, that factor is the delivered cost of chemicals. Let us quote from a recent communication from him on this subject:

> It has always seemed to me that producers concern themselves entirely too much with what it costs to make goods and entirely too little with what the goods finally cost the consumer. The results of such analyses are apparent all over the country. Large production units have been developed where it was to the advantage of the producer from a cost standpoint to do so, while the consumer has taken it "on the chin" because he has had to add transportation to the cost of the goods. It is a sort of "consumer-be-damned" policy and it is that policy which has induced an enormous number of substantial-volume consumers to go into the chemical business where they well know they do not belong. By the simple process of ignoring his problem we have, in many cases, driven him to do what he did not care to do, and would not have done if we had figured delivered cost instead of f.o.b. cost.

The Department of Commerce program, if it is to have most practical appeal to chemical industry, could well include some consideration of the economics of plant location in relation to important markets. The sentimental appeal of a "back-to-the-farm" movement for industry will be lost unless it can be put on a more practical dollars-and-cents basis.

Unwanted Fluorine

DEFINITE progress is being made by phosphate chemical producers in the manufacture of products of lower fluorine content. Food and drug regulation is the force behind the scene, and its workings are not particularly screened from public view, either. Food officials have had great difficulty in regulating the lead and arsenic content of foods and feeds. They have forced entomologists to a considerable extent to modify insecticide spraying programs, and fluorine containing insecticides are being offered generally as substitutes.

This does not greatly please the Food and Drug Administration. It is quite as much against traces of fluorine in foods as it is against the heavy-metal contaminants formerly encountered. Hence there is definite pressure for limiting the fluorine content of foods including those which contain phosphoric acid or phosphate chemicals. Makers of insecticides, as well as phosphate chemicals must take note of this official thinking.

Chiseling by Means of Purity Specifications

CHEMICAL PURCHASERS in the present buyers' market are chiseling by a new method, all too common. Under the new scheme they are tightening up on purity and performance specifications of commodities far beyond normal requirements which previously have been deemed adequate. Seemingly, the urge to get a good bargain from chemical purveyors is thus satisfied when price chiseling will not work.

The general trend to superior quality of chemical products is logical and should be encouraged. But excessive purity demand, or too rigorous specification, raises costs needlessly; and in the long run will prevent otherwise proper price reductions. There should be more widely recognized the mutuality of interest between supplier and purchaser in this regard. A recognition of the real relationship which exists, can readily eliminate, to the advantage of both contractual parties, the annoying specification practices that have been cropping up so frequently of late.

Rock Wool: A Potential Industry

CHEMICALLY-PRODUCED insulating materials are an important prospect for the near future. Among the outstanding opportunities of this character appears to be rock wool, a material that when properly made is moisture-proof, vermin-proof, reasonably vibration-proof, and otherwise highly desirable for both industrial and household insulation. An interesting article on its manufacture appeared in *Chem. & Met.*, Vol. 29, pages 365-7.

Illinois officials have been investigating the fundamental scientific principles which underlie the woolizing of rock. They are now able to tell us, and do in their Bulletin No. 61 of the State Geological Survey, just what minerals can be used, the precise chemical composition required, and many other features which must govern manufacture.

Numerous process industries are looking for new products to make. Rock wool may offer an opportunity for some of these. In any event, it deserves further industrial investigation.

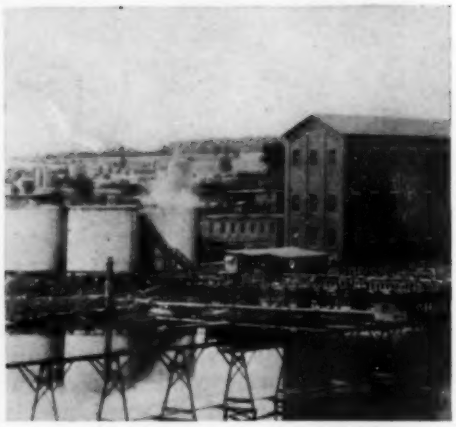
A Proposition On Packaging Problems

WE WISH we might wrap up in an attractive package and deliver to each of our readers a complete guide and reference book for solving all of the varied and difficult problems met in the packaging of chemicals. That wish appears at the moment to be impossible of fulfillment. Nowhere, as far as we can learn, has anyone assembled in printed form all of the needed information and data that would be of help to all individuals in chemical industry who share in the responsibility for efficient packaging. But we do propose to do something about it, and with your interest and cooperation we are certain that much can be accomplished.

Here is our proposal: In this issue *Chem. & Met.* begins the publication of an unusual series of articles which, when completed, will have covered practically every important phase of the chemical container problem. The author, R. W. Lahey of the American Cyanamid Co. is widely recognized as an authority who has already contributed constructively both to thought and action in this field. One of his ingenious products received an award in the recent competition of the American Management Association. His article in the present issue deals with the problem of proper management and organization to obtain most efficient packaging. In the January issue he discussed packages from the viewpoint of promoting better relations between producer and consumer of chemicals. Subsequent contributions to the series will summarize the official regulations for the transportation of dangerous chemicals, container costs and detailed discussions of the construction of the different kinds and types of packages, accompanied by critical analyses of their advantages and disadvantages.

But, you ask, what does the reader contribute? Is this all "take" and no "give"? We hope not, for, frankly, the ultimate value and completeness of our coverage will depend largely upon your cooperation. We propose to start a *"Readers' Forum on Chemical Packaging"* in the May issue of *Chem. & Met.* Leading questions pertaining to container problems will be asked and answered in letters from interested readers. The first of these questions, on container testing, appears on page 134. We hope you are willing to answer it, to let others share in your viewpoint and experience. With that sort of cooperation, strongly supported by Mr. Lahey's contributions, we may yet be able to deliver to you before the year is out that complete and useful package of packaging information and reference data.

By JAMES A. LEE
Managing Editor,
Chemical and Metallurgical Engineering



REFINING THE SALT OF THE EARTH

FROM ANTIQUITY salt has played an important part in the life of man, as indicated by the many colorful references to it which have come down through the ages. And considering its steadily growing industrial use the modern chemical engineer may well say with the ancients that the salt has indeed not "lost its savor." In the first place, he is concerned with it as a vital ingredient in his own food; secondly, he finds it a valuable raw material upon which to practice his engineering skill in producing chemicals some of which are of basic importance; thirdly, his ability is tested in the development of suitable processes for its refining; and finally, he is continually confronted with the corrosion of equipment used not only in these refining processes, but wherever salt is handled.

Salt produced from mines, wells and ponds in this country, in 1933, amounted to the grand total of 7,604,972 short tons, valued at $22,315,086, according to U. S. Bureau of Mines. Of this quantity 573,240 tons were recovered by evaporation in open pans or grainers and 1,310,676 tons by evaporation in vacuum pans. While there are an almost unlimited variety and number of uses for salt, by far the most important from the standpoint of volume consumed is in the production of heavy chemicals. The salt content (3,461,026 tons) of the brine produced and used by producers in the manufacture of chemicals represented 46 per cent of the total output. Most of it is used for the production of soda ash and caustic soda as is shown in the accompanying estimate of the consumption in the process industries. However, the soap, leather, pulp and paper and other process industries are also large consumers of salt.

In the handling and processing of salt, equipment must be used that will withstand the corrosive action. And any one who has ever had occasion to handle salt knows that it corrodes many of the ordinary materials from which equipment is usually constructed. However, by the judicious use of a few carefully selected metallic and non-metallic materials this troublesome problem may be solved. The engineers of Worcester Salt Co. have accomplished this by employing in addition to cast iron and steel, a nickel-copper alloy, copper, and maple and white pine woods. A trip through the Silver Springs, N. Y., plant of this company, which, incidentally, is one of the largest plants producing salt from brine in the country, furnishes many interesting illustrations of where and how these materials may be used to lengthen life of equipment and to insure satisfactory color and purity of the product.

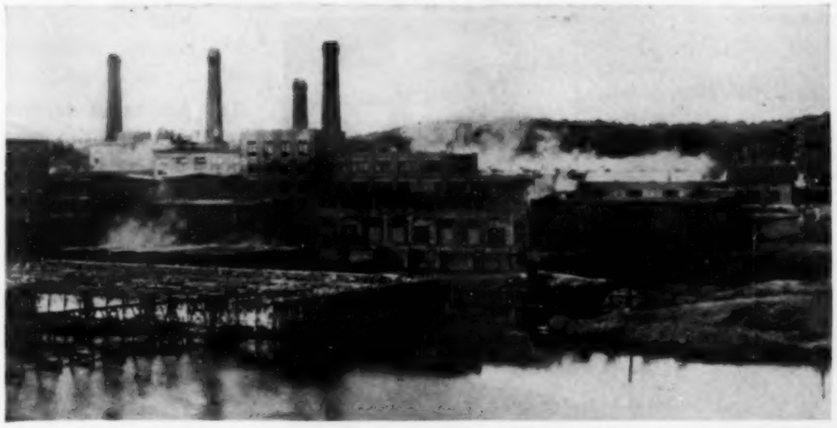
This plant obtains its principal raw material, salt brine, from a 100-ft. strata of rock salt located at about 2,200 ft. depth, below the plant site. Twelve wells are employed, two for conveying the fresh water used for dissolving the salt to the rock strata below and the other ten for bringing the salt brine to the surface by

Estimated Consumption of Salt in the Process Industries in 1933

Products		Short tons
Heavy chemicals	soda ash	2,585,000
	caustic soda	421,000
Electrochemicals		175,000
Fine chemicals		10,000
Coal-tar products		300,000
Fertilizers		5,000
Leather		100,000
Soap		100,000
Glass and ceramics		50,000
Pulp and paper		50,000
Textiles		40,000
Vegetable oils		10,000
		3,846,000

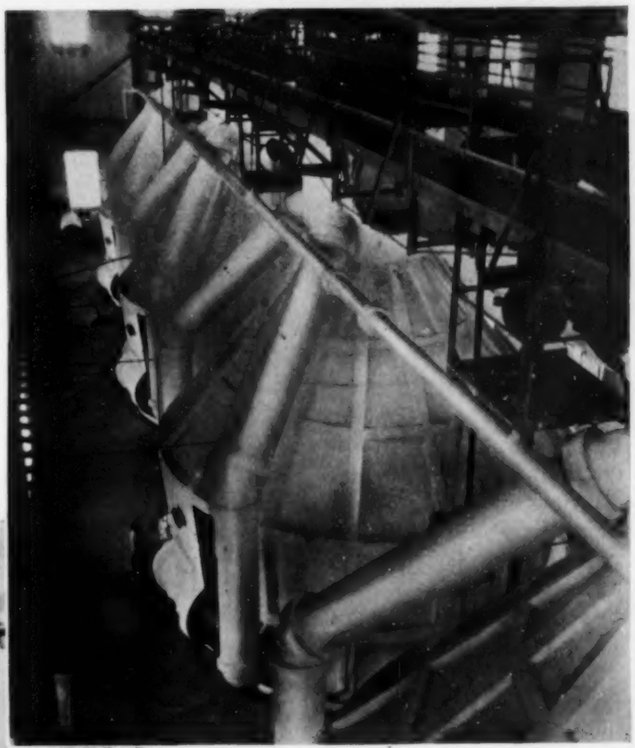
Salt Sold or Used by Producers in the U. S., 1933
(Bureau of Mines)

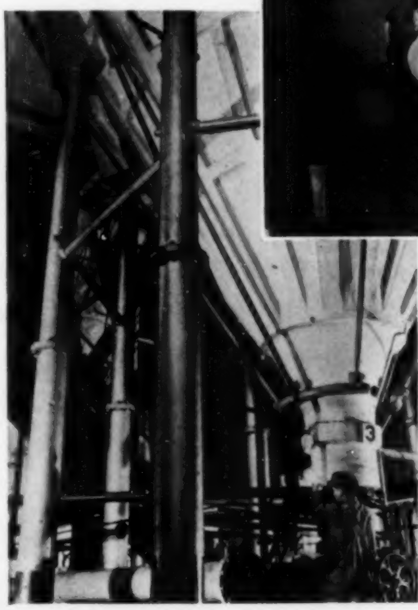
Method of Manufacture	Short tons
Evaporated in open pans or grainers	573,240
Evaporated in vacuum pans	1,310,676
Solar evaporation	322,368
Pressed blocks from evaporated salt	152,670
Rock	1,754,487
Pressed blocks from rock salt	30,505
Salt in brine (sold or used as such)	3,461,026
	7,604,972



Refinery of the Worcester Salt Co. at Silver Springs, N. Y. Settling vats in foreground

Top and bottom of quadruple effect evaporators in the Silver Springs refinery. They are 65 ft. high and 22 ft. in diameter and are said to be direct lineal descendants of the Duncans' original evaporators



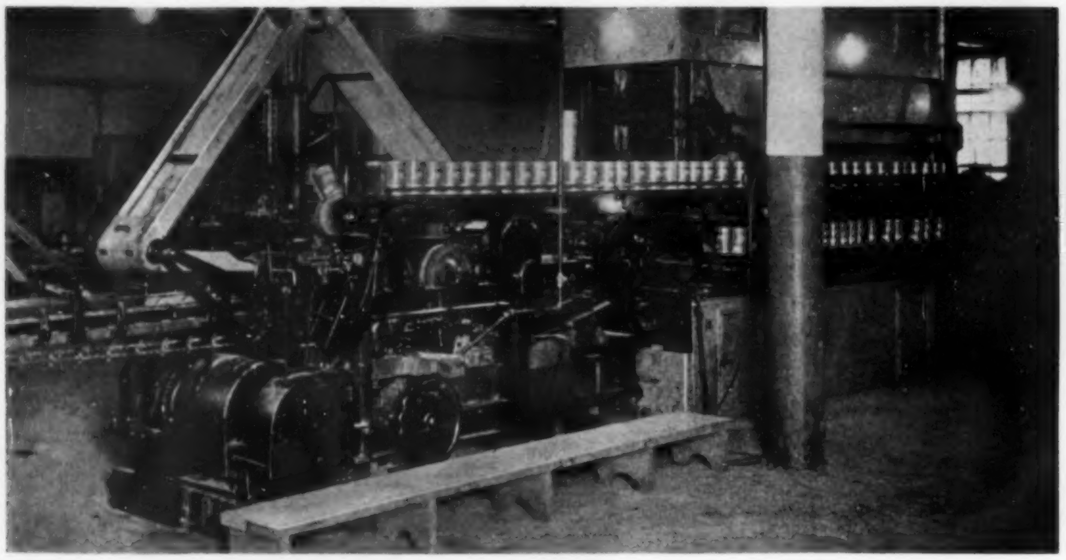


means of compressed air. The brine has a composition of about 25 per cent sodium chloride, 0.6-0.7 per cent calcium sulphate, 0.2-0.3 per cent calcium chloride, 0.1 per cent ferrous chloride, and a trace of magnesium chloride.

When the brine reaches the surface, it is conveyed by gravity in pine flumes to the settling tanks, large open vats of white pine. This species of pine is preferred to spruce and certain other woods which shrink under this condition. There are 34 of these tanks, each with a working capacity of about 25,000 gal. The brine is first treated with lime water to precipitate the iron, which also carries down some of the calcium sulphate. By the same operation the brine is made slightly alkaline which is necessary for good evaporation later in the process. After about 24 hours, when the iron has settled to the bottom, the brine is given a treatment with soda ash to remove the calcium by precipitation as carbonate. This in turn carries with it more of the calcium sulphate. After another waiting period in order to permit settling, the clear brine is ready for evaporating and crystallizing.

Two methods are used for recovering the salt, vacuum pans and grainers. The latter, which are open vats constructed of a low-copper steel painted with a resistant finish, are long, shallow pans equipped with hoods which carry off the vapors; they are heated with steam coils placed 6 in. above the bottom. By proper control of the temperature uniform crystals may be produced; as these are formed they drop to the bottom and are raked to the front end by a series of slow-motion mechanical rakes faced with Monel metal; the lips of the grainers are also covered with the same corrosion-resistant alloy. The rake dumps the salt onto a rubber-belt conveyor running through a washer where the impurities on the surface of the salt are removed. It is then conveyed to Oliver filters where the moisture is reduced and from these to rotary dryers for final moisture removal. The dry flake salt goes to large vibrating screens where it is sifted, graded, and conveyed to maple-lined bins. Finally, it is weighed on automatic scales and packed into moisture-proof barrels or bags.

About 1886, Joseph and John Duncan, working in the Silver Springs refinery, conceived the idea that salt could be evaporated under vacuum with better results. These brothers developed a vacuum drying pan which produced a refined salt of greater purity, luster and fineness of grain than hitherto had been known. Theirs is said to be the first commercial vacuum pan used for the manufacture of salt in the United States (W. C. Phalen, Technology of Salt Making in U. S., Bureau of Mines, Bulletin 146). And these same pioneers were the first to employ the centrifugal principle to the drying of salt. From their early vacuum pan, which was a success from the start, have been developed the



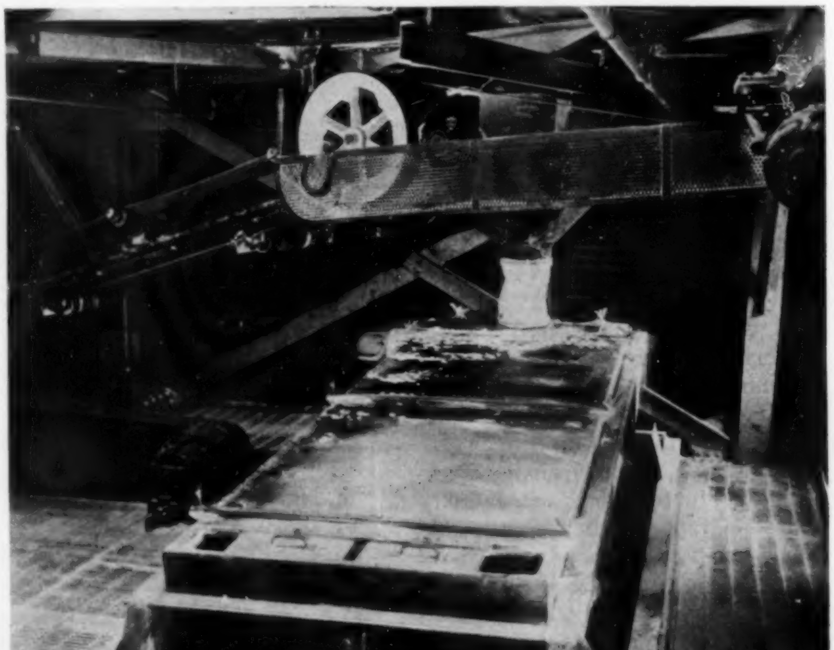
The packaging department is one of the most important in the entire Silver Springs salt refinery. Many types and sizes of containers must be used to package this product to meet customer demand

quadruple-effect evaporators used in the plant at the present time. These are enormous affairs—cylindrical devices 65 ft. high and 22 ft. in diameter with a daily capacity of 800,000 lb. of salt. The flue sheets and pans of the bodies are iron construction and the tubes are copper. Because of the rapidity with which salt crystallizes in these evaporators, fine cubical crystals are formed which distinguish vacuum pan salt from that made by other processes.

The salt crystals drop to the bottom of the evaporators and are carried off by a stream of brine solution; the volume of solution required for this purpose is approximately the same as that of the crystals removed. The impurities clinging to the surface of the crystals are washed off by the fresh brine and by the action of the washer into which they are conveyed from the vacuum pans. The washer is a rectangular tank equipped with Monel metal conveyors which separate the brine and salt. Evaporators must be shut down every 32 to 34 hours and the calcium sulphate and carbonate cleaned out. The pumps empty the 140,000 gallons of brine in the evaporators in 20 minutes.

From the washer the crystals and brine go to Oliver filters equipped with Monel metal screens where all but 2 per cent of the moisture is removed from the salt. The crystals leave the filter in four streams and are conveyed to 45 ft. revolving cylindrical dryers. Since these dryers are slightly inclined, the salt travels slowly through them, while heated air flowing in the opposite direction removes the last traces of moisture. From the nickel-copper alloy-lined dryers the salt is elevated in an alloy bucket conveyor to the two cylindrical coolers which are cooled with conditioned air. Here the salt is cooled to proper temperature for packaging and shipping. It is then elevated from the coolers to the screen room where it is passed through silk bolting cloth, separated into three sizes, and delivered to

Vibrating screen used for sifting and grading



maple-lined bins. From here the salt goes to automatic machines, which weigh and pack it into moisture-proof round or square cartons, or into barrels or bags of various sizes.

For the production of the "free running" grade of salt for household use choice runs of the best quality salt are weighed into large mixers equipped with revolving blades where 1 per cent, by weight, of tricalcium phosphate is added. Mixing is done so thoroughly that every grain of salt is coated by the filter. To produce the "iodized" salt a tricalcium phosphate containing potassium iodide is used, so that final product has 0.02 per cent potassium iodide.

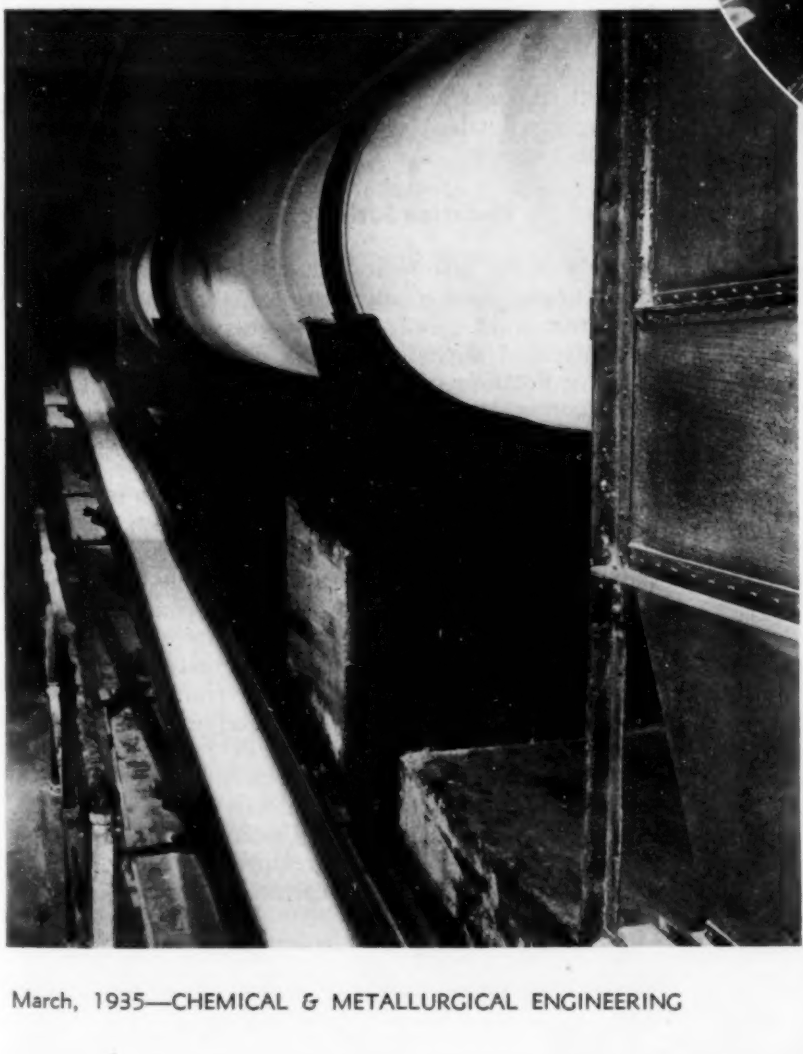
Most of the salt refined at the Silver Springs plant of the Worcester company is shipped in the packages already mentioned or in bulk in railroad box cars lined with clean paper. However, some of the salt is pressed into blocks for cattle lick, or used in the preparation of such new developments as automobile windshield wipers for winter service and tooth paste. While these products are interesting because they are new outlets for salt, the volume is small as compared with the other applications.

A high degree of purity of the product is attained by employing mechanical handling throughout the process and by the use of construction materials resistant to the corrosive and abrasive action of the salt and corrosive action of the hot and cold brine solutions.

Some idea of the resistance of nickel and nickel alloys to the corrosion of salt may be had from the result of tests made by the development and research organization of the International Nickel Co. Metals in saturated brine at 180 deg. F. in the salt grainers, where naturally there is an absence of air, after a period of 60 days show an extremely small amount of corrosion.

Metal	Corrosion rate in mg./sq. dm./day	in. penetration/yr.
Monel metal	1.0	0.00016
Nickel	1.2	0.0002
Ni-Resist	1.8	0.0003

Metals exposed to a saturated salt spray, steam and air at 200 deg. F. for 30 days show the following measurements:



Interior and exterior views of one of the seven huge rotary dryers. They are lined with a corrosion resistant alloy. Note continuous ribbon of salt passing upward on a belt conveyor as it leaves the dryer

Metal	Corrosion rate in mg./sq. dm./day	in. penetration/yr.
Monel metal	13	0.0027
Nickel	13	0.0022
Ni-Resist	25	0.005

While corrosion tests made in a rotary vacuum salt dryer with alternating exposure to saturated brine and hot air for 145 days give the following results:

Metal	Corrosion rate in mg./sq. dm./day	in. penetration/yr.
Monel metal	1.4	0.0002
Ni-Resist	8.3	0.0016

The corrosion rates in inches penetration per year for tests made by fastening insulated specimens to the lining in an oil fired salt dryer for 86 days are:

Metal	Distance from feed end of dryer 8 ft.	12 ft.	20 ft.	28 ft.
Monel metal	0.011	0.009	0.007	0.009
Nickel	0.0055	0.004	0.006	0.011

In the case of the steam heated dryer the corrosion rate was even lower:

Metal	Distance from feed end of dryer			
	8 ft.	12 ft.	20 ft.	28 ft.
Monel metal	0.0002	0.00015	0.0003	0.0002
Nickel	0.0001	0.0001	0.0001	0.00007

The difference in corrosion rates between the oil fired and steam heated dryers is due principally to the greater amount of salt handled per hour by the oil fired dryers and probably also to the additional corrosives introduced by the sulphur compounds in the flue gases. It is interesting to note that the results of these tests check very well with practical experience. Measurements of salt dryer linings after long periods of use have indicated, in the case of oil fired dryers, rates of thinning of Monel metal of the same order as that indicated by the corrosion test data. In the case of steam heated dryers, experience has checked the corrosion test data, since the life of Monel metal linings appears to be indefinite.

▼ ▼ ▼

Concentration of Potash Ores At Carlsbad

DOMESTIC production of potash has made rapid strides during the past four years, with an increase from 109,820 tons of potash-bearing material, containing 61,590 tons of K_2O in 1929, to 331,110 and 143,378 tons, respectively, in 1933. This was chiefly due to the development of the potash deposits near Carlsbad, N. Mex. In this district a mixture known as sylvinite, with 40 parts of sylvite (KCl) and 60 parts of halite (NaCl), is mined. As the usual chemical method for recovering potash from this mineral is costly and requires expensive equipment experiments have been undertaken at U. S. Bureau of Mines to apply ore-dressing methods to the problems to produce a grade of potash suitable for the fertilizer industry. After preliminary studies, the investigation was extended under a cooperative agreement between the Bureau, the Potash Company of America, and Missouri School of Mines. The following is an abstract of a report of this study, Bureau of Mines Report of Investigations 3271, by Will H. Coghill, F. D. DeVaney, J. Bruce Clemmer, and S. R. B. Cooke.

The results of the investigation show that the Carlsbad ore may be concentrated by ore-dressing methods if a closed circuit of brine, saturated with the constituents of the ore, is used. Any one of the following three procedures will yield high-grade concentrates and high recoveries: Table concentration supplemented by flotation, tabling an agglomerated feed supplemented by flotation, and all-flotation.

Gravity Concentration

Plain gravity concentration on tables yielded concentrates analyzing 82.7 per cent KCl, with a recovery of 69.8 per cent. When the fines were treated by flotation the final concentrates contained 84.9 per cent KCl, with 97.3 per cent recovery. The other two methods gave higher concentrates and equally good recoveries.

The relative weights of the minerals in the concentrating medium is of first consideration for gravity concentration. A saturated brine (sp.gr. 1.23) is the only worthy medium in this case. Hydraulic classification should be the first step in tabling where, as here, the difference between the minerals to be separated is small. If the material is sized by screens the tabling depends solely upon the difference in densities. With hydraulic classification both densities and grain sizes have a pyramiding effect in favor of a good separation.

Agglomeration, or selective filming of KCl in the presence of NaCl, may be used in connection with table concentration. In this separation the forces of nature work in unison—KCl is lighter than NaCl and by that property alone it tends to pass over the side of the table. When a water-repellent coating is superimposed on the KCl grains they film on the liquid interface, and the separation is accelerated. In a recent test over 96 per cent of the KCl was recovered in a concentrate analyzing 95 per cent KCl, with only 3 per cent KCl in the tailings. Agglomeration is at its best on 10 to 48 mesh material and promises to double the capacity of the tables. Of the reagents tested sodium and ammonium alkyl sulphates and related compounds gave best results. The reagent cost was about 80c. per ton of ore treated, but the increased table capacity should help to compensate for this expense.

Flotation Satisfactory Method

Early in the investigation it was appreciated that flotation might prove a satisfactory method for separating KCl from NaCl. Only slight success was obtained until the sulphated aliphatic alcohols were used. Excellent selective flotation of KCl, combined with low reagents consumption, has been effected with these reagents and related compounds, particularly the derivatives of alcohols with 8 to 12 carbon atoms.

Only small quantities of these reagents are necessary; a reagent cost of about 18c. per ton of ore has resulted through re-use of the brine. The simplicity of flotation should be stressed; the process is applicable to all grades of ore, and high-grade and low-grade concentrates are readily produced. Only a small quantity of a single reagent is required, and a froth with good characteristics results. The reagent is very selective and flotation exceptionally rapid. To insure high recovery the ore should be at least as fine as 35 mesh.

Flotation tests on the hydraulic classifier overflow from the tabling tests and on table tailings showed that these products were amenable to such treatment. Only a very small quantity of reagent is required in these cases to give a high recovery in concentrates with more than 85 per cent KCl.

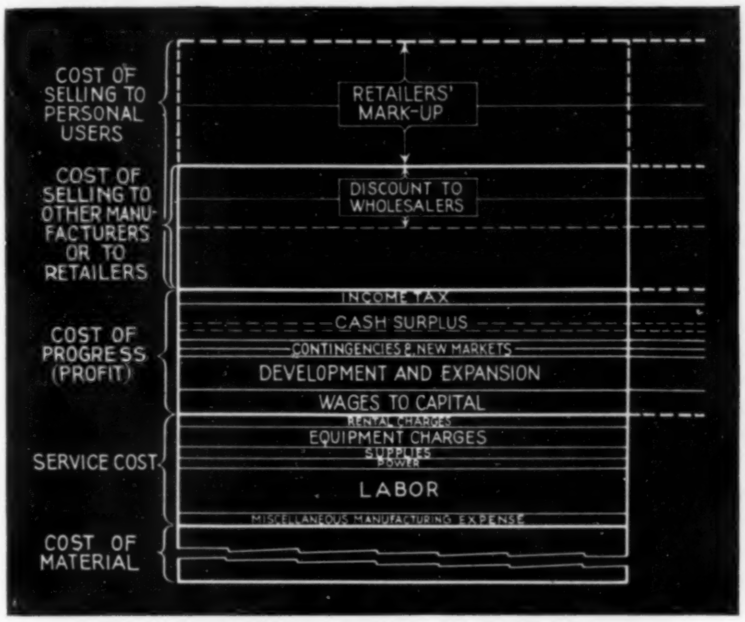


Fig. 1—Typical economic right-price structure showing relations of elements of cost

How to Price for PROGRESS

By W. L. CHURCHILL
Vice-President, John R. Hall Corp. New York, N. Y.

Editor's Note:—In an article in our January number Mr. Churchill showed the need for a realistic, scientific pricing system. In the following article he explains how such a system can be attained.

COST AND PRICE, from the engineering viewpoint, are identical; a fact which means that the economically correct price is simply a summation of all of the elements of normal costs entering into the production and distribution of a product, plus those costs which will serve to perpetuate the business and guarantee continued improvement and progress in processes and producing facilities. The primary elements of cost or price are:

1. The normal cost of service rendered (production);
2. The normal cost of marketing;
3. The normal cost of progress, including distributable profit; and
4. The normal cost of materials occurring in the products sold.

The term "normal" is used, it should be noted, in describing the cost of each element. Thus comes about an important distinction between *price engineering* and the customary methods (or lack of method) in price determination.

The normal cost is that cost encountered when an operation is performed in a normally efficient manner, under normal conditions. When normal costs are used throughout in the development of "right prices," the more efficiently managed enterprises earn (and collect) more than normal "costs-of-progress" and can, therefore, make greater and more rapid progress than their less efficient contemporaries. This is distinctly in the public interest as the greater the progress of an enterprise, the more effectively it serves. Its products and services tend to lessen in cost or increase in value.

Among the elements of "normal conditions," the price engineer recognizes that there is a normal percentage of productive capacity that industry ordinarily employs and that to base prices (i.e., costs) upon the sale of greater than normal volume invites disappointment and, possibly, disaster. Few, if any, industries produce and sell more than two-thirds of their single-shift capacity throughout a complete business cycle; recognition of this economic fact does not preclude anticipating immediate increase in capacity, but it does establish prices which insure against disappointment in the event that need for increasing capacity fails to occur.

It is one of the curious absurdities of business conduct that the almost universal tendency is an arbitrary reduction in prices when business is in excess of normal—when, incidentally, demand is such as to make reductions unnecessary—and also to reduce prices when business is below normal, just when greater income is needed. Price engineering, however, normalizes all cost factors so as to make prices stable, permitting the collection of reserves in periods of better than normal business to buffer the drop in earnings and offset what lowering may inevitably occur in periods of subnormal business.

Briefly stated, the price engineer does not permit variation in management or operating efficiency, or variation in sales volume, to affect price conclusions. All prices are always based upon normals and, therefore, remain unchanged when once established, until actual changes in price factors occur. This brings us to a description of the price engineer's "price structure." (See Fig. 1.)

Cost-of-Service—The price engineer first determines what should be the normal annual cost for operating the production facilities of the enterprise at the normal proportion of its capacity. The sum of these costs is termed "cost-of-service" (or service costs). The diagram illustrates the proportionate subdivision of cost-of-service in a particular case. The subdivisions will obviously vary greatly in their relations to each other and to the total cost-of-service with different enterprises. They are illustrated here to indicate more fully the items included in this price element.

The price engineer does *not* obtain these figures from

records, but arrives at them by actual study and measurement of values involved in each required element of service cost. He strives to include every justifiable item and at highest justifiable value. He is not interested in determining how low costs may be driven downward, but rather in placing the highest consistent value upon all services rendered and in converting "latent" to active earning power.

Cost-of-Progress—The major section above cost-of-service represents "cost-of-progress" (including distributable profits). It will be observed that the total of this price element equals the total of cost-of-service, but also has added to it an area representing income tax at the top and a dotted line extension to the right. This signifies that right prices must include for cost-of-progress an amount at least equal to the normal cost-of-service. It also indicates that income taxes should likewise be included and that there are circumstances and situations that justify substantial increase in the cost-of-progress element of price. There is apparently no economic justification for including less than the basic requirement, i.e., an amount equal to total cost-of-service.

The subdivisions of cost-of-progress, as illustrated, represent the apportionment in a typical case example.

In the application of this principle of providing for the perpetuation of a business enterprise, the price engineer has applied the actuarial principles that have proven so successful in the perpetuation, improvement, development and progress of the life insurance industry. On the basis of price engineering the manufacturer is told how much he *must* include in his prices for this element. It is by far the most important and vital part of the right-price structure.

The fact that cost-of-progress must at least equal cost-of-service gives a further reason for the employment of the best of talent and ability on service functions and for employing the best of equipment and facilities to aid in rendering service. The higher the justifiable service cost, the greater the rate and degree of progress.

Cost-of-Marketing—Immediately above the cost-of-progress section in Fig. 1 is the "cost-of-marketing" section, equal in dimensions vertically and horizontally to the cost-of-progress section, except for the added dotted section above the basic cost-of-marketing. This shows that in order to collect all normal costs of production (including materials), and normal costs-of-progress, there must be expended in marketing effort an amount equal to the total cost-of-progress. This formula applies to sales made to other manufacturers for use or for inclusion in their products and also to retail dealers for resale to household or personal users.

The dotted square at the top of the diagram indicates that the final mark-up for prices to household or personal users should at least equal the basic cost-of-marketing. Discounts to wholesalers for resale to manufacturers and to retailers, it should be noted, should not exceed one-half of the basic cost-of-marketing.

Materials purchased, and identifiable in finished products, are to have their normal costs added to the total of service prices, the latter being the sum of cost-of-service, cost-of-progress and cost-of-marketing. There must be no addition to material costs for cost-of-progress or cost-of-marketing. Probably no single fallacy in typical pricing practices so distorts prices from their just and equitable levels as the fallacy that permits and encourages percentages to be added, directly or in combination with other costs, to the prices paid for materials appearing in finished products. This factor alone has been found to create price conclusions of two-and-a-half times the right price for some items of a single manufacturer's line, offset (unintentionally) by other items priced as low as 40 per cent of their right prices.

Deficitless Operation

In Fig. 2 is illustrated the effect upon operating statements of variation in sales volume from normal, when the principle of right-price operation is adhered to:

The illustration is a typical case example based upon prices determined for a normal output of two-thirds capacity. Therefore, along the line of normal capacity, the service-costs and progress-costs are equal, while marketing-costs are equal to progress-costs plus income tax.

Follow the angle lines downward to the left and note that at 60 per cent capacity the subdivision of progress-costs labeled "extra dividends, bonuses, etc.," has disappeared. Service-costs have been reduced but marketing-costs must continue at their full normal amount. At 54 per cent capacity common dividends must be passed (or reserves used). Marketing-costs are still maintained in full, although service-costs are further reduced. Then, at 46 per cent of capacity, preferred dividends are passed (or reserves used), but marketing continues at full strength while service-costs are further reduced. At 40 per cent capacity "reserves" are passed. At 35 per cent of capacity, if the combination of continued research and full normal marketing effort has been unable to stem receding business, it is then time to retrench by reducing marketing-costs as indicated.

In price engineering the fact, that all service-costs are specifically reduced to costs per unit produced, enables accounting to adopt the much-sought-for method of charging depreciation, amortization and other so-called fixed charges on a basis paralleling production. This produces a logical shrinkage in these fixed charges with shrinking volume and increases them in times of extra volume.

With the use of the engineering principle of depletion for depreciation, etc., and following the procedure of reducing mar-

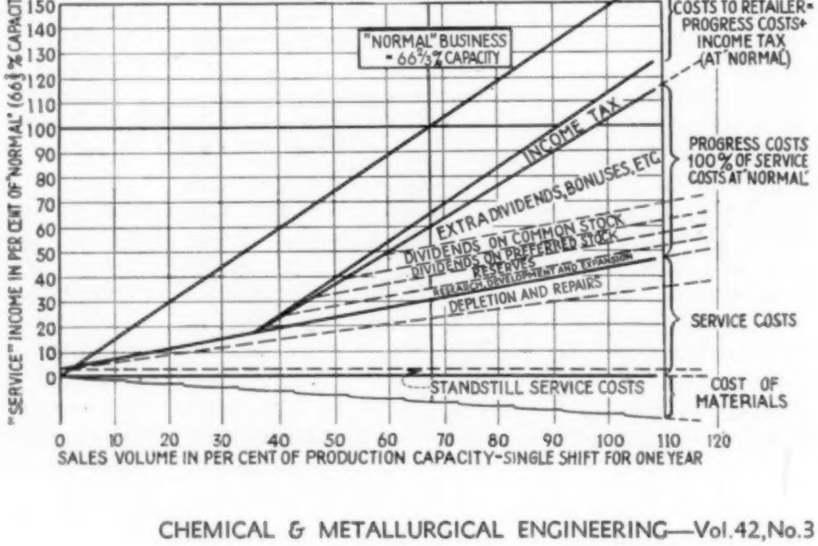


Fig. 2—"Deficitless-operation" chart showing effect of varying sales volume on a business employing right prices

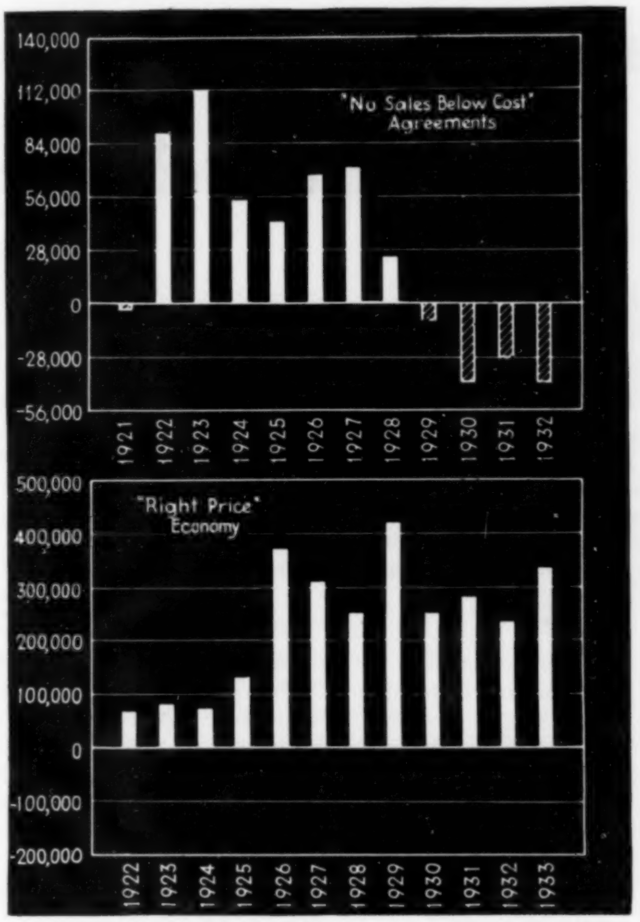


Fig. 3—Profit experiences of two actual concerns, one making "no sales below cost," the other operating under a right-price economy

keting effort when production shrinks below 35 per cent, there need be no deficit reported in operating statements until actual stoppage of all production.

Maintaining marketing effort in full and research in full should insure against the shrinkage of volume to such disastrously small dimensions as 35 per cent of capacity, provided that all sales are conducted upon a basis of technically right prices at all times. Concerns that have followed this policy have had no occasion to report deficits, even during the lowest portions in our business depression.

The next most important points to bear in mind, after establishing the correct cost-of-progress (including profit) and developing the technically right prices, are that the full normal marketing effort must be constantly maintained and ample research and development work continued so that products and processes will both be kept at the peak of efficiency.

Getting Right Prices

From Fig. 1 it was clear that the manufacturer's prices to different classes of buyer necessarily vary under right prices. The net prices in the several cases will equal the cost of raw materials plus: three times the service-costs, in the case of sales to manufacturers or retailers; or plus four times the service-costs, to households and personal users; or plus $2\frac{1}{2}$ times the service-costs, to wholesalers. Many readers, however, who may attempt to calculate prices by these formulas may jump to the conclusion that since the use of the formulas reduces many of their prices below those already established, it will, therefore, be desirable to apply such formulas to other presumably overpriced products and services. Manufacturers should be forewarned, however, that unless they are prepared also to revise currently underpriced products upwards to their right levels, it may prove the height of folly to even consider a partial revision.

The business man who is afraid of prices that must be elevated should leave all prices alone. There is no need to fear price elevation when such elevation is justified and demanded by the true price facts. Price engineering has reached a stage of development where it is capable of solving the problem of getting the right prices when these prices are known. Very frequently the engineer discovers that supposedly high prices are in reality already too low. With equal frequency he discovers supposedly low prices are too high. There is so little consistency between prevailing prices and the economic price requirements that the wonder is not that so many of our enterprises fail, but that as many as 4 concerns in every 100 really make consistent, continuous profits and progress over a period of a generation or more.

Group Action Versus Individualism

The most prominent reaction to the proposition that price and cost should be synonymous and must include the economic requirements for progress and for adequate marketing effort is that it would be perfectly lovely if everyone would follow such natural laws. Statements to this effect are usually followed with another to the effect that "of course it would be no use for any one concern alone to follow such a course."

This thought, that it is necessary for group action to insure success, is utterly fallacious. The 4 per cent of enterprises that are consistently successful are not members of any group or groups that by force of cohesion secure such success. The majority of these successful concerns stand out from their fellows as individualists—enlightened individualists, if you will, not predatory but constructive—as valuable examples for all to follow.

From prevailing evidence one might, with some show of justice, assert that group action is impossible and that it is only when each concern works out its own price engineering problems that permanent success can be achieved. In Fig. 3 are two charts which tend to confirm this view. The upper chart represents the profit (and loss) experience of a progressive manufacturer who joined a group of competitors in an agreement "not to sell below cost." Cost was defined as all costs of manufacturing. Of course, all members immediately sought cost reductions and lowered their prices to meet competition, keeping them, however, above their receding costs—for awhile! But the inevitable result was bitter price wars, after all had exhausted their cost reducing ingenuities, and loss to all with disaster to many.

Quite a different picture is shown in the lower chart. Here was a manufacturer who cut loose from a price agreement similar to the above and decided to adopt the policy of basing his prices and sales upon price engineering principles. The contrast between results of the two firms, of substantially equal ability, size and opportunities, is a clear illustration of the advantages of enlightened individualism as against price agreements under any guise or form. This concern is one of a growing number that conducts its pricing for *progress* as well as for *profits*. Its example is one that all may follow.

Proper Management for Efficient Packaging

By R. W. LAHEY

American Cyanamid Co., New York, N. Y.

Following Mr. Lahey's introductory article in the January issue of Chem. & Met.**, this is the first of an unusual series of practical discussions of the problems met in the selection, testing and use of chemical containers. We feel that many readers may wish to save and file these articles for ready reference since, when completed, they will comprise a veritable handbook of useful information and data on the packaging of chemicals. Suggestions, comments and criticism are invited.**

PROFIT making companies invariably have their many departments well managed and properly organized. But even in these concerns it is sometimes found that they fail to extend their principles of organization and management to the function of packaging their products, an oversight which is probably due to the mistaken idea that packaging problems are easily and efficiently handled by an operating department as a minor part of its job. This work must be so arranged that it dovetails into the activities of the several departments that are concerned with the problem and at the same time it must proceed smoothly and harmoniously.

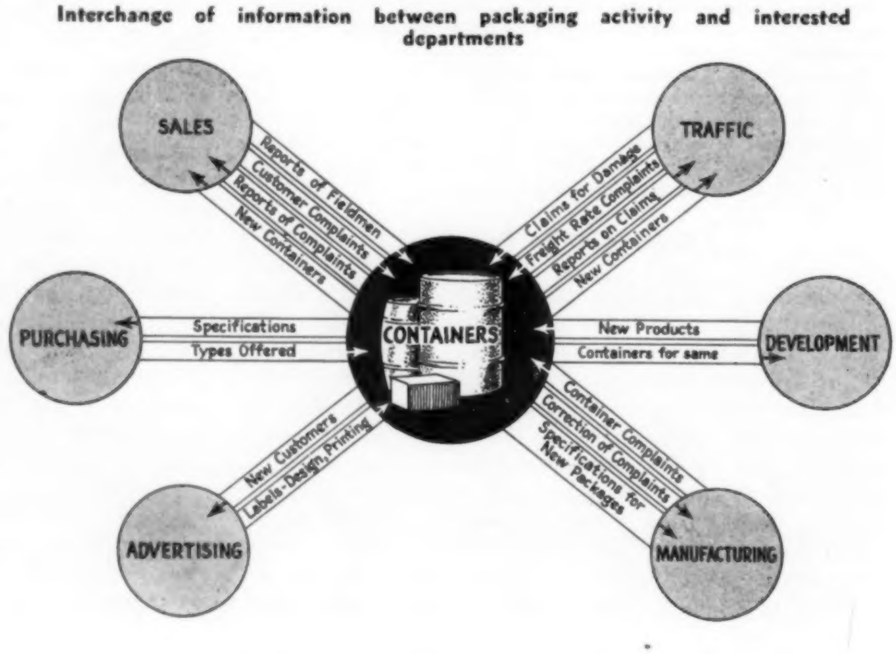
Let us consider the point of view of each of the interested departments towards the container problem. (1) Manufacturing costs are influenced to a substantial degree by the packing, handling, and container costs. (2) Containers play an important part in the efforts of the sales department to build sales, to create customer goodwill, and to render efficient service. (3) The advertising department has an opportunity to coordinate container printing and labeling with the general advertising plans and campaigns. (4) The traffic department can minimize freight rates and reduce damage claims by proper choice of containers. (5) The purchasing department is able to buy more efficiently by choosing standard containers manufactured by more than one concern thus offering the advantages of competitive bidding.

All of these departments share a part of the container responsibility, but each department has other duties that are paramount to it. It is not reasonable to expect department managers or plant managers, with their many more important duties and problems, to adequately study the packing problems. It is therefore unfair to saddle upon these individuals the responsibility for packaging when it is physically impossible for them to devote the required time to obtain the necessary knowledge and to make comprehensive investigations. Perhaps the unfairness of placing this responsibility on one or more departments where it must be a secondary consideration can best be realized by contemplating the information which must be obtained in order to do an efficient packaging job.

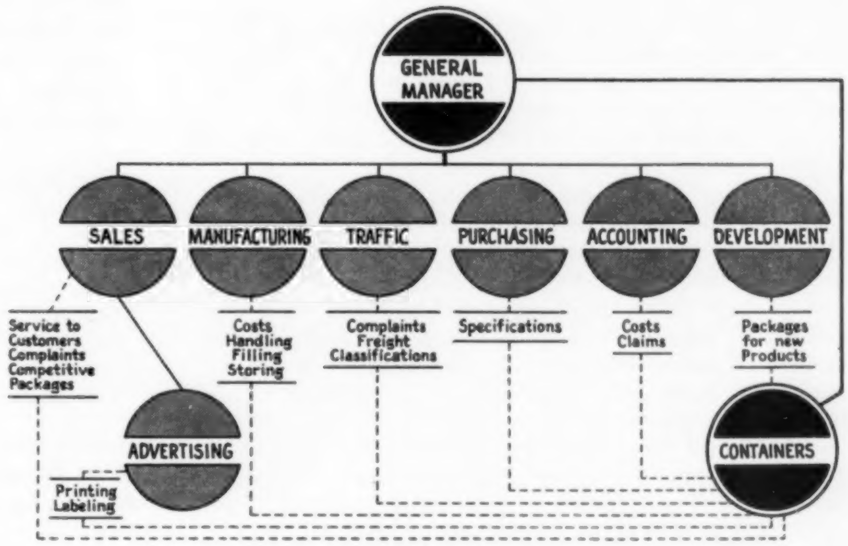
1—It is necessary to be acquainted with the filling and handling equipment of the factory that manufactures the product. The hazards of the several types of transportation must be known. And familiarity with the customers' conditions is necessary, which involves the handling methods, the most convenient size unit in the use of the material, and the conditions under which the material is dispensed from the package.

2—It is desirable to have a knowledge of the general types and kinds of packages in use and the good and bad features of each. One must be versed in the prin-

Interchange of information between packaging activity and interested departments



# of Chemicals



Organization chart

cipal processes of making these containers. Consider only heavy duty bags. There are burlap, cotton, paper, rubber, and grass bags, and each of these types has several subdivisions. A knowledge of the printing limitations of each style of bag is desirable. It is also advisable to be acquainted with the twist, count and strength of yarns used in textile bags as well as the types of weaves, count, weight, standard widths and strength of the cloth. Textile bags are sometimes made of cloth with creped paper cemented together with adhesives. Often plain, coated, or laminated loose creped paper liners are inserted in textile bags to prevent contamination and sifting of the product. The common methods of filling and closing bags must be known as well as bag filling and closing machines. A knowledge of bag closing materials is required.

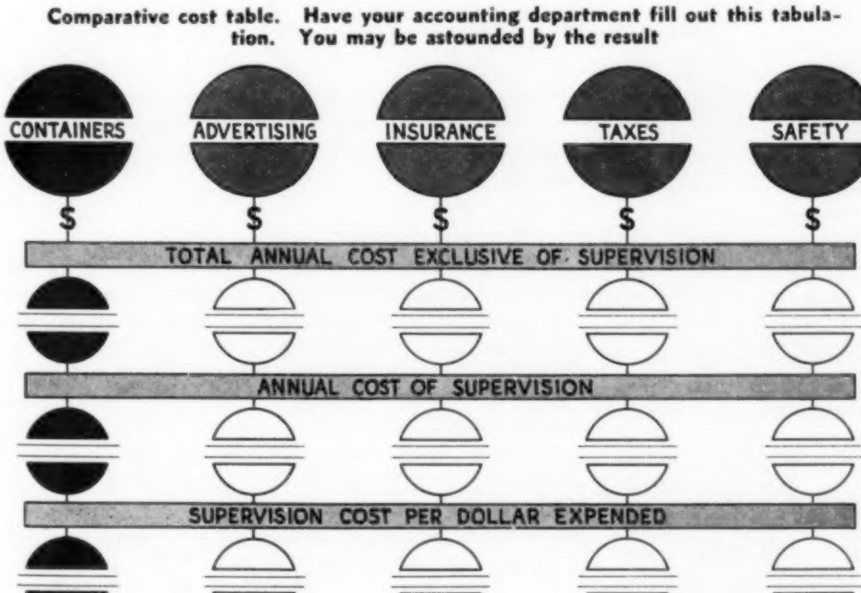
There still remains the question of moisture resistant textile bags which is of great importance in the chemical industry. This involves questions of the available types of asphalt, their melting points, and any other moisture resistant compounds which might be used for adhering the paper to the cloth or laminating two sheets of paper.

And still we have not discussed heavy duty paper bags of which there are as many types as there are textile bags. The details of construction are just as involved, and the same moisture-proofing, closing, and filling problems exist.

The foregoing is a brief description of the knowledge required about bags; and this same type of information is necessary for single-trip light-weight steel drums, returnable heavy steel drums, fiber drums, lead, glass, and earthenware jugs and bottles, barrels and kegs, wood veneer drums, gas cylinders, tank cars, paint pails, tin cans, and corrugated, fiber, and wood shipping cases.

3—Most chemical companies ship materials which are classified as dangerous by the Interstate Commerce Commission. These products must be packed, labeled, and shipped in accordance with the "Regulations for the Transportation of Explosives and Other Dangerous Articles by Freight and Express," the "Regulations for the Transportation of Explosives and Other Dangerous Articles on Freight and Freight and Passenger Vessels by Water," and the "Regulations for the Transportation of Explosives and Other Dangerous Articles on the Public Highways by Motor Truck and Other Vehicles." The regulations are in great detail; for example, the first book contains 381 pages with the addition of four supplements of 140 pages covering revisions in the regulations. The second set consists of 33 pages and the last one 28 pages. In order properly to handle container problems one must have a general knowledge of these regulations. Considerable time is required in the proper study of them, and as at least one or two changes a year are made the matter of study is a continuous one that must not be overlooked.

Comparative cost table. Have your accounting department fill out this tabulation. You may be astounded by the result



Coupled with this, it is necessary to be acquainted with the procedure for requesting additions to or changes in the regulations as well as the best channels to obtain information on any questions that may arise on interpretations of the regulations.

It is therefore clearly evident that container problems of large chemical companies should be the main or only responsibility of one or more individuals. There are tricks in the container trades as there are in all others, and even a partial knowledge of these tricks results in savings in container expense.

There are no statistics available on the annual container and packaging cost of the chemical industry; and therefore it is impossible definitely to show the vast expenditure involved, but it amounts to many millions of dollars each year. It is suggested that you have your accounting department prepare a statement showing your annual container bill and the expenditures made for packaging control, if they can be segregated. Then, have this compared with the expenditures for advertising, insurance, taxes, and safety and show the expense of maintaining the advertising department, insurance supervision, tax accountant, and safety activities. It is believed that such a comparison will plainly show that the cost of supervision per dollar expended for containers will be much less than the cost of supervision per dollar expended for those other activities. Undoubtedly your advertising, insurance, tax, and safety problems are handled by an expert or by a department supervised by an expert. Certainly container problems warrant the same type of expert handling and supervision.

The establishment of a packaging department depends on the size of the company and on the particular type of organization into which it is fitted. It is a difficult job to handle the container problems in a large company with its several manufacturing plants and with its many varied products. The knowledge required for the work makes it necessary to choose a man with special training of the kind previously discussed; or if an untrained man is picked, he should be given the opportunity and ample time to acquire this information.

Your packaging representative should not report to the manager of an interested department, as the decisions of these men are unconsciously influenced by that individual angle of the container problem in which they come in contact in their field of work. Packaging activities which are so organized that they are independent of any of the departments involved will secure the most economical and the best all around containers. It can readily be seen that the sales department wants a container that pleases the customers; the manufacturing department wants one that is inexpensive and easy to fill, close, handle, and store; the traffic department wants one that requires the lowest freight rate and on which the minimum damage claims are filed. Unfortunately it is not always possible to choose a container which meets all these provisions and therefore the choice must be made after deciding which packages provide the most advantages.

Although the packaging engineer should be free from the influence of any of the department managers, it is absolutely essential that he cooperate with them to the fullest extent. It is his duty to satisfy all of the interested departments; and if any container falls short of doing this, it is the responsibility of the packaging man and the matter should be forcibly brought to his attention by the department affected. This scheme has the desirable feature of having the work done independently but at the same time the accuracy of it is checked by several vitally interested departments.

Container matters are sometimes handled by a committee composed of representatives of sales, manufacturing, traffic, purchasing, and advertising departments, but this is not recommended unless the committee acts in an advisory capacity only. It is impossible for these men to have a detailed knowledge of the subject and if they share the responsibility there is danger that they will over-rule the package man.

Members of the sales department can be of great value in the packaging work as they occupy the "listening post" position on the business front. If they are observant and transmit information promptly to container headquarters, much trouble and expense can be averted and no other company will enjoy a competitive sales advantage through the use of better containers for any appreciable period.

The man in charge of containers should have the privilege of visiting customers' plants in order that he may become acquainted with their storing, handling, and using conditions. Sales departments are sometimes reluctant to grant this privilege; but if the packaging representative is of the right type, he can implant in the customers' minds the fact that he is interested in his problems and attempting to provide him with every convenience.

Many companies require their sales representatives to send in to the main office on forms provided for the purpose detailed reports of their calls. It would be of considerable assistance if space on these forms were provided for salesmen to answer the following questions:

1—Describe any new kind of container used for packing a competitive product. What advantages or disadvantages does the customer claim for this package? Send in a sample of the complete package.

2—What is the customers' opinion of our containers? State advantages and disadvantages with suggestions for improvement.

All information which is obtained from this source

Can You Answer This One?

Question: What preliminary tests should be applied to a shipping container for chemicals to determine accurately whether or not it would prove satisfactory for this type of service? Are different tests used for bags, barrels, drums and boxes?

The editors of **Chem. & Met.** would like to have your answer to this question for publication in a **Reader's Forum on Chemical Packaging** which will appear for the first time in our May issue. You are cordially invited to participate in this discussion—to present your own problems or your solution to those proposed by others. May we hear from you?

---

should be tabulated and action taken promptly as indicated by the data. Care should be taken to make sure that the conditions reported are not isolated cases in the trade; but after it has been ascertained that the findings apply to the majority of customers, prompt action should result as indicated by the findings.

All complaints should be investigated by the package man as quickly as possible and any necessary changes made with all possible speed. A report should be issued to all departments interested with a clear statement of the cause of the trouble and the steps taken to correct it. Even with the best of knowledge available, mistakes will be made in the choice of containers and means must be provided that these errors come to light promptly and that they be corrected quickly.

Sufficient time should be taken to become familiar with the manufacturing operations for all types of containers which are in use. This involves trips through factories and discussions with container manufacturers. It is most important that this work is not neglected, as an intimate knowledge of the individual manufacturing methods will pay large dividends in the form of savings in cost. There is certain information about the construction of each type of container which if known and used in packaging work will show astounding results.

Familiarity with container construction will insure the use of standard sizes and types which is so desirable from the standpoint of the purchasing department. Suppliers of containers will sometimes attempt to have their users adopt non-standard packages for the reason that they have special equipment. The result of this is that other suppliers cannot make this particular type or size and you are therefore limited to one source of supply. Acquaintance with the manufacturing methods and the standard sizes and types of this particular package will help to avoid such common pitfalls.

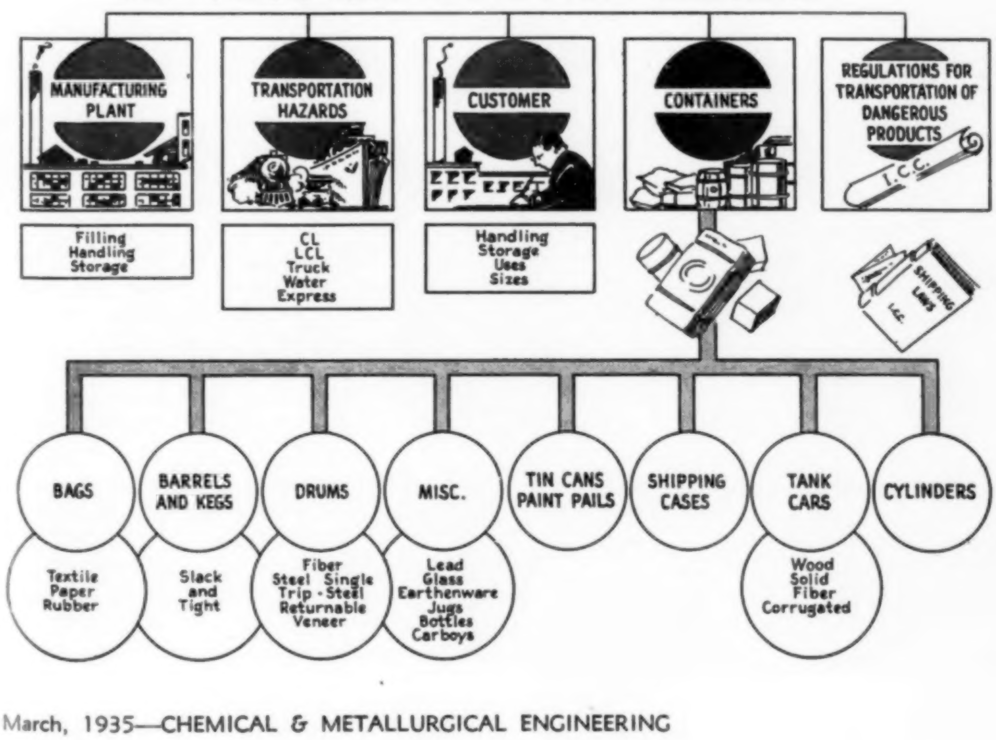
New products which a concern places on the market are a result of the research work of the development department, and often this research work is extended to package development. Chemists and engineers are so engrossed in the technique of producing a new product commercially that the packing problem is usually not confronted until the manufacturing problems have been solved. This invariably results in a considerable loss of time which in some cases has proved very costly. There is no reason why the packaging problem cannot be solved by the time the product development work is completed if the activities of the packaging engineer are coordinated with the work of the research department. As in the case of the production department it is unfair to ask the research men to work on problems with which they are not familiar and which usually take their time away from more important work.

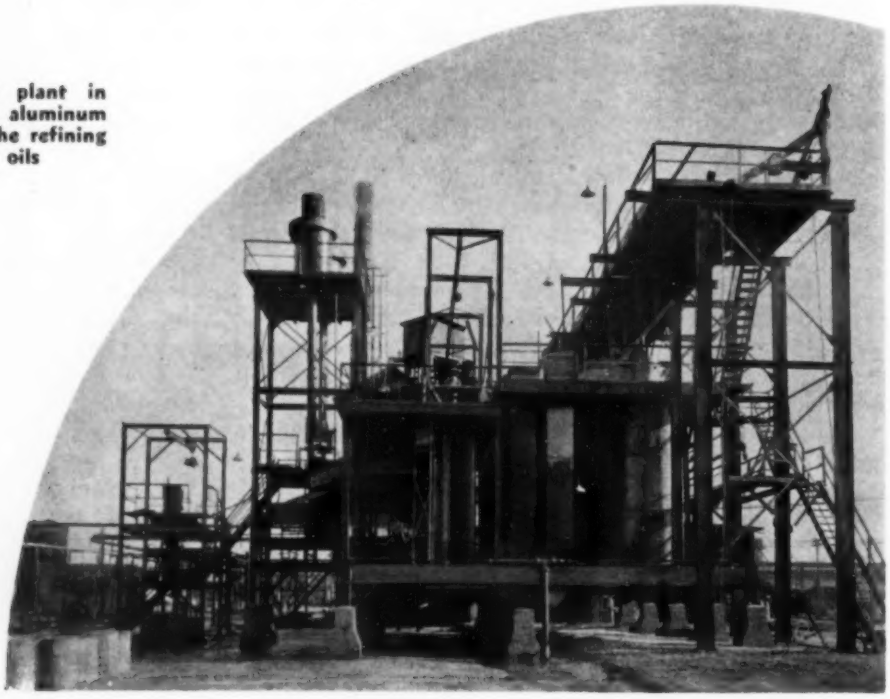
This discussion has been limited to consideration of the organization problem facing large companies with a multiplicity of products and with several manufacturing points, but there are a great many small and medium sized organizations with fewer products and manufacturing plants. The methods used for efficient handling of containers in a large company are probably not applicable to the smaller organizations. The size of the company, the number and type of products, and the number and location of producing points all have a bearing on the kind of management which will most effectively cope with the problem.

It is probable that a company which is relatively small and makes only a few products will find that it is too expensive to use the entire time of a man on packaging problems. In this case these duties should be assigned to an individual who has some other responsibilities which are connected with containers. He may be located in the manufacturing, purchasing, or traffic departments. After the original investigation has been made and the package and method of packing chosen his principal duty is to make certain that the containers in both design and construction are kept up to date. The importance of this should not be underestimated as frequent and rapid changes are constantly occurring in the container field, and unless one is always alert he will find that he has fallen behind the procession. To guard against this the sales department must watch the packages of competitors and pass on information promptly.

Under existing business conditions, manufacturing costs of most concerns are about equal, and their selling prices and the quality of their products must be competitive for them to stay in business. To be first in the adoption of an improved type of container will often result in a temporary competitive advantage. Sometimes a saving in manufacturing costs can be obtained through the fact that packaging problems are often neglected by competitors, and it is the wise and alert management that organizes to take full advantage of it.

What a packaging engineer should know about chemical packages





Side view of new plant in which anhydrous aluminum chloride is used in the refining of lubricating oils

Refining Motor Oils by the Alchlor Process

By A. M. McAFEE

Superintendent, Aluminum Chloride Department, Gulf Refining Co., Port Arthur, Texas

A LUBRICANT has been defined as an agent that decreases friction between moving surfaces. Such a definition classifies a large number of substances as lubricants. Water, graphite, soap, vegetable oils and petroleum are all lubricants by this definition. There is no one agent which can be called a universal lubricant —one that can be used between all moving surfaces under all operating conditions. A compressor compressing oxygen into steel cylinders to 2,200 lb. pressure must use a lubricant which is non-reactive with oxygen. Water containing a small amount of soap is a satisfactory lubricant in this case; vegetable and petroleum oils cannot be used on account of their great reactivity with pure oxygen, more especially so under pressure. Certain hydrocarbon constituents of petroleum, commonly known as lubricating oils, come the nearest nowadays to being the universal lubricant.

In addition to the hydrocarbons, there are other elements and compounds present in small quantities in petroleum such as sulphur, oxygen and nitrogen, which are generally looked upon as impurities to be disposed of in refining. A discussion of these impurities it not necessary here. The number of different hydrocarbons constituting petroleum amounts to several thousands. But comparatively few individual hydrocarbons have been isolated and to date there are only a limited number of practical uses for them.

The property that characterizes petroleum lubricating oil is its viscosity. To be a lubricant it must be viscous enough to maintain a fluid film between the moving surfaces under all conditions. While it is true that lubricating oil must have viscosity, it does not follow that any oil which has viscosity is a good lubricant. Many crude oils as they come from the ground are viscous, but few, if any, are used in the natural state as lubricants. Now we are in a position to consider what are the properties which motor oils should possess. Let us not confuse our thoughts by the use of the technical jargon of the petroleum industry. I could talk about sludging values, Conrad carbons and viscosity indexes of motor oils; but why do that if the desired properties can be expressed in language which all of us can understand from our daily experience?

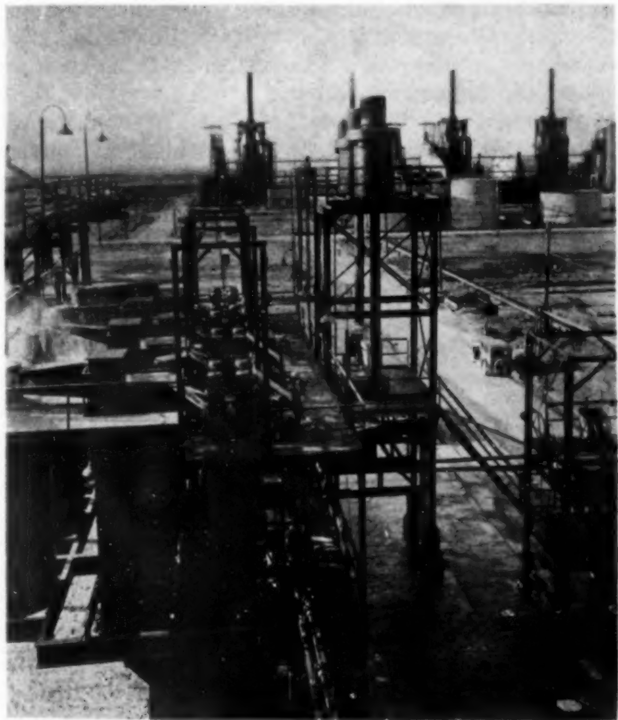
When it became popular to refer to the anti-knock

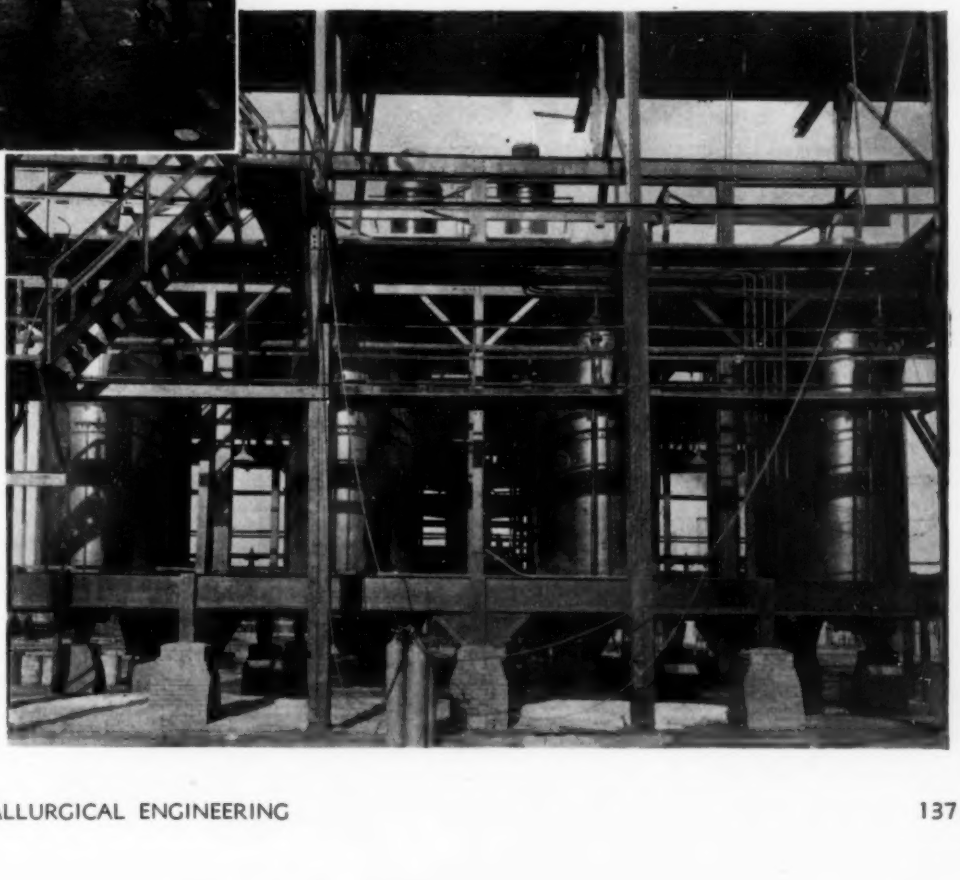
When Professor E. P. Schoch of the University of Texas asked the author to participate in the recent Quarter Centennial Celebration of the Division of Natural Resources, he writes me that his first impulse was to say "No." "I have appeared on such occasions only twice before, once in 1915 in San Francisco at a meeting of the American Institute of Chemical Engineers and again at a similar meeting in Philadelphia in 1929. These appearances were 14 years apart, hence to maintain the record, I was not due to appear again until about the year 1943. Then I counted up and found that I had graduated from Texas 25 years ago. That coincidence won me. So we celebrated our twenty-fifth anniversaries together!" Some of the remarks our modest friend made on that occasion form the basis of this brief paper.—EDITOR.

quality of gasoline by its octane number, I am reminded of the motorist who wanted gasoline containing 70 octanes per gallon. What do you want of the motor oil in the crankcase of your automobile engine? I expect the first thing you would say is that you want it to last a long time. Then you want to feel that during this time the oil is flowing freely through the lubricating system to all moving parts. Then, you want any oil which passes the piston rings and enters the combustion chamber to volatilize and get out without leaving behind a solid residue that must be cleaned out by hand. And finally, you want adequate viscosity at the highest as well as the lowest operating temperature of your engine. Now we may say what the motor oil should do in the modern high speed automobile engine. It should (1) resist oxidation as much as possible; (2) leave as little carbon on volatilizing as possible, and (3) change as little in viscosity with change in temperature as possible.

The ideal motor oil would be one which cannot be oxidized; one which leaves no carbon on volatilizing; and one which has the same viscosity at all operating temperatures. Why? Because such an oil would not oxidize to form sludge to clog the lubricating system and would certainly last a long time; would leave no carbon in the combustion chamber to be cleaned out; and would have the same viscosity on a cold morning when starting up the motor as it would have after the motor has been driven, say, 100 miles at top speed. Such an ideal motor oil has never been produced from petroleum. All petroleum lubricating oils are subject to oxidation; deposit carbon on volatilizing and become less viscous with rise in temperature. The best we can do, therefore, is to recognize the qualities of the ideal motor oil and approach these qualities as near as possible.

In my course in Organic Chemistry at the University of Texas, under Professor Bailey, there was one re-





Top and end views of the alchlor process plant of the Gulf Refining Co., Port Arthur, Texas. When this plant went into operation in November, 1934, it marked the beginning of the second large scale use of cheap anhydrous aluminum chloride produced from bauxite by the McAfee process. The application of the Friedel and Crafts' reaction first to gasoline and now to motor oils, dates back to work started by author at the University of Texas twenty-five years ago.

action that he particularly stressed, namely the Friedel and Crafts' synthesis, discovered in 1877. The textbook we used then was Holleman's "Organic Chemistry." I still have that textbook, which I prize highly because on the margin on page 363 I wrote in the year 1907 the words "Exceedingly useful." These were the words used by Dr. Bailey during his lecture that year on the Friedel and Crafts' reaction. On this page Holleman says "Friedel and Crafts' synthesis is peculiar to the aromatic series and depends on a remarkable property of aluminum chloride." Five years later when I took up the study of petroleum hydrocarbons, it was not surprising that I should question why the action of aluminum chloride was "peculiar to the aromatic series."

I found that crude petroleum when heated with anhydrous aluminum chloride undergoes profound internal changes. There is a rearrangement of the various hydrocarbons and removal of unstable bodies. My San Francisco paper before the American Institue of Chemical Engineers (see *Met. & Chem.* Vol. 13, pp. 592-7, 1915) was entitled "The Improvement of High Boiling Petroleum Oils and the Manufacture of Gasoline as a Byproduct therefrom by the action of Anhydrous Aluminum Chloride." In that paper I showed that when crude petroleum is distilled in the presence of aluminum chloride, lower boiling hydrocarbons are produced, leaving a residual oil free of asphaltic and resinous constituents. Thus a dual role was played by this remarkable chemical, one of conversion and one of refining. Both actions can be made to take place simultaneously or separately depending upon the temperature employed. At boiling temperatures all the high boiling constituents of crude petroleum can be converted into gasoline, gas and carbon, but at lower temperatures, the lubricating constituents are freed of those bodies which are more easily oxidized, deposit excessive carbon on volatilizing, and which are more susceptible to change in viscosity with change in temperature.

Not until several years later was the quality of these products required by industry. As the automobile engine was improved with respect to higher compression and higher speed, anti-knock gasoline became of importance and improved motor oils were also required. It was then that lubricating oils refined by aluminum chloride came into their own because they more nearly approached the qualities of the ideal motor oil. Gulfpride oils made by the alchlor process were then made available, first in small amounts and then in larger quantities each year as their merits were recognized through actual performance and not by fanfare of trumpets. Within the last few months, sulphuric acid has been largely replaced by organic solvents for refining lubricating oils. Undoubtedly solvent refined oils are superior to those refined by sulphuric acid, but I believe there is none that cannot be made to approach nearer the ideal motor oil by refining with aluminum chloride.

I am glad that these products were ahead of their time, because the hard job ahead required a concentration of effort unhampered by the desire for immediate production. That job was how to make aluminum chloride. Long before my time Von Baeyer had said that the uses of aluminum chloride sound like a fairy story. Unless this chemical could be made from basic raw materials cheaply and in thousands of tons, I had added more fairy stories. There was no precedent to follow. It was easy to make it from metallic aluminum and chlorine but for industrial uses metallic aluminum as a starting material was out of the question on account of its cost.

The story of the fifteen years of work at Port Arthur and the large amount of money required to solve what seemed at times to be insurmountable obstacles in this difficult chemical engineering problem, was told in my Philadelphia paper before the American Institute of Chemical Engineers (see *Chem. & Met.*, July, 1929, pp. 422-4). Hence it need not be repeated here. Suffice it to say that paper told how Gulf was making aluminum chloride from bauxite, at the rate of 75,000 lb. daily and at a cost such that it could be sold in carload lots at 5 cents per lb. Contrast this with the fact that in 1913 I purchased 100 lb. of aluminum chloride at $1.50 per lb., waiting six weeks to get delivery. It is not surprising that some of the fairy stories to which Von Baeyer referred took on industrial significance immediately after the publication of that paper. Thus I have given a running account to date of the founding and development of an enterprise which has been conceived and developed in Texas during the past 25 years. To Gulf Refining Co. goes the credit for making these developments possible.

Unique design and construction materials are required for a process utilizing anhydrous aluminum chloride, which readily hydrolyzes to produce free hydrochloric acid. Gulf has had more than twenty years of experience in the manufacture and use of this interesting chemical

New Process Converts Waste Ferrous Sulphate to Sulphuric Acid

By S. F. SPANGLER
Chemical Construction Corp.
New York, N. Y.

IT OCCASIONALLY FALLS to the lot of the chemical engineer to have the privilege of working out an important process for the economical utilization of a waste, which is not only a nuisance and cause of continuous disposal expense, but a vicious source of stream pollution as well. A recent process by which the solution of weak sulphuric acid and ferrous sulphate resulting from the pickling of steel plate is converted into a fresh, strong sulphuric acid is one of the outstanding examples of such constructive development.

For many years steel mills have been among the largest consumers of sulphuric acid. In its January, 1935, number, *Chem. & Met.* estimated the American consumption during 1934 for pickling iron and steel products at 475,000 tons of 50 deg. Bé. acid, equivalent to 295,000 tons of 100 per cent H_2SO_4, or approximately one-twelfth of the country's total production of this basic chemical. This represents a considerable increase over the consumption during 1933 and 1932, although it is still far below the consumption during pre-depression years.

The use of sulphuric acid for the pickling of steel produces a byproduct, ferrous sulphate, which is not marketable in any quantity approaching the amount normally produced. This byproduct is in the form of a somewhat dilute solution containing free acid. Expensive evaporation and crystallization are necessary before a marketable ferrous sulphate can be produced. Except at a few mills producing comparatively small quantities of sulphate solution and which are also favorably located to sell ferrous sulphate, the common practice has been to discharge the pickling liquor as waste into any convenient stream or body of water. Naturally, this procedure has met with the opposition of public authorities charged with the prevention of stream pollution, since ferrous sulphate, and to an even greater degree, free sulphuric acid, are detrimental to vegetable and fish life. Where the discharge of the acid liquor has been prohibited, it has been necessary to install expensive neutralization processes which produce no byproduct of value, but merely reduce the sulphate solution to a neutral effluent carrying considerable calcium sulphate. The disposal of waste pickle liquor has consequently been a source of contention and expense to the steel industry.

Chemical technologists have suggested the use of waste pickle liquor as a raw material for the manufacture of sulphuric acid. Theoretically, ferrous sulphate can be oxidized into ferric sulphate and the latter can be roasted to give iron oxide and sulphur trioxide. In fact, roasting of ferric sulphate was the first method used for the manufacture of fuming or Nordhausen sulphuric acid. Also, theoretically, ferrous sulphate when roasted alone will decompose as follows:

$$2FeSO_4 = Fe_2O_3 + SO_2 + SO_3$$

However, the production of sulphuric acid from a mixture of equal volumes of sulphur dioxide and sulphur trioxide presents many mechanical difficulties and is not considered economically feasible.

Other engineers have suggested that the ferrous sulphate could be roasted in the presence of a reducing agent so as to liberate only sulphur dioxide which could then be used in the usual manner for the production of sulphuric acid. Two processes for making sulphuric acid from sulphur dioxide are in common use. In the older lead chamber process, the dioxide is oxidized to trioxide by nitrogen oxides in large lead chambers and the moist trioxide condensed to form sulphuric acid. This process requires sulphur dioxide at high temperatures in its initial stages. In the contact process, the oxidation is effected in the presence of a catalyst and the trioxide is absorbed in strong sulphuric acid. Formerly platinum was the only known commercial catalyst and great purity was required in the sulphur dioxide gas admitted to the catalytic converter or oxidation vessel in order to prevent poisoning or damaging of the platinum catalyst; consequently contact acid plants were complicated and expensive in design and difficult to operate. This situation was changed by the commercial introduction of non-poisonable vanadium catalysts in 1927 with the result that all recently built American sulphuric acid plants employ a simplified contact acid process.

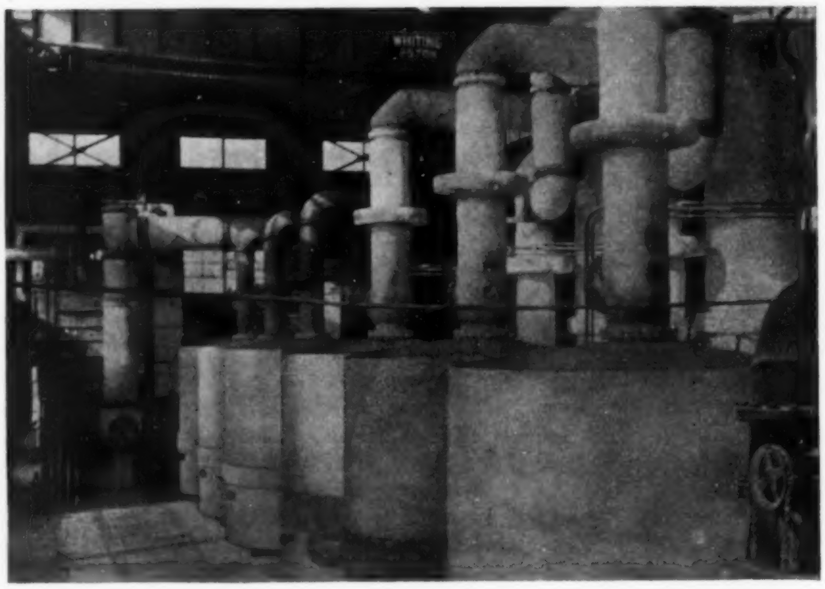
About ten years ago the engineering department of the Chemical Construction Corp., then located at Charlotte, N. C., gave considerable study to the utilization of ferrous sulphate and developed a process of roasting in the presence of a reducing agent that would give a gas satisfactory for use in a chamber acid plant. The pickle liquors then available contained comparatively small quantities of free acid and neutralization was not considered a serious problem. Unfortunately, the types of equipment required, and the relatively great cost of small chamber acid plants, rendered this process unattractive except on a very large scale and no commercial installations were made.

The late I. Hechenbleikner, then vice-president and chief engineer of the Chemical Construction Corp., sub-

sequently developed the "Chemico" sludge conversion process which employs a rotary kiln for the decomposition of refinery acid sludge into sulphur dioxide. Refinery acid sludge is essentially a mixture of sulphuric acid and hydrocarbons and the success of the rotary kiln in the sludge conversion process suggested its use for reducing metallic sulphates, to Mr. Hechenbleikner and his associates. A small rotary roaster was erected at the pilot plant at Charlotte and satisfactory reduction of solid ferrous sulphate to iron oxide and to sulphur dioxide suitable for use in the contact acid process was accomplished.

The earlier experiments had shown the necessity of having an almost anhydrous ferrous sulphate for satisfactory reduction. The ferrous sulphate obtainable by direct crystallization from pickle liquor contains seven molecules of water of crystallization and the dehydration of this heptahydrate, or copperas, had long been recognized as a difficult problem. The success of the rotary roaster in the decomposition of the sulphate led to its consideration for dehydrating copperas, and to the idea of combining neutralization of the free acid in the pickle liquor with the dehydration. It was found that both neutralization and dehydration could be accomplished safely in one rotary kiln, heated internally by combustion gases, by utilizing some of the iron oxide produced in the subsequent reduction of the dehydrated sulphate to neutralize the free acid that was present.

Ordinarily, pickle liquor will not react with iron oxide cinders but a reaction involving complete neutralization of the free acid will take place under the controlled conditions of temperature and concentration occurring in the dehydrating kiln. This was successfully demonstrated in 1932 with synthetic pickle liquors in a semicommercial pilot plant.



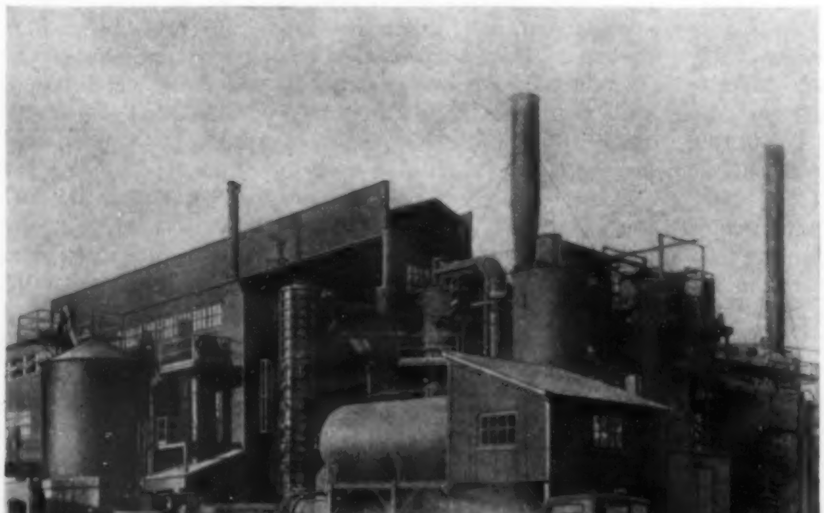
Section of Titanium Pigment Co.'s contact acid plant showing a group of vanadium catalyst converters

The Chemical Construction Corp., commencing in 1932, offered to design and construct plants for the manufacture of sulphuric acid from waste iron sulphate solutions according to a process involving the following steps:

1. Neutralization and evaporation of the sulphate solution in a rotary dehydrator, employing iron oxide for the neutralization of the free acid, and producing an almost anhydrous iron sulphate.
2. Decomposition of the anhydrous iron sulphate in a rotary roaster, producing sulphur dioxide gas of proper concentration for subsequent use in a contact acid plant, plus iron oxide cinder, part of which could be utilized for the neutralization of additional sulphate solution.
3. Conversion of the sulphur dioxide into sulphuric acid of any desired strength in a modified form of the standard Chemico contact acid plant, using vanadium catalyst.

General business conditions in the steel industry in 1932 and the immediate subsequent years operated to prevent the installation of the process on a commercial scale with pickle liquor. However another industry, also producing waste iron sulphate solutions in large quantities, was operating at high capacity during these years. The manufacture of titanium dioxide for pigments involves the treatment of ores containing iron and titanium with sulphuric acid and the production of a waste liquor contain-

Contact sulphuric acid plant of Titanium Pigment Co., St. Louis, built to operate on waste ferrous sulphate



ing 18–25 per cent free H_2SO_4, 10–16 per cent $FeSO_4$, and traces of titanium sulphate. While the relative quantities of free acid and iron sulphate differ somewhat from those commonly found in steel pickling liquors, the problem of using this titanium waste liquor as raw material for the manufacture of sulphuric acid proved susceptible to the same solution. After this had been conclusively demonstrated in the experimental plant, the Titanium Pigment Co., Inc., authorized the erection of a large commercial plant at St. Louis, Mo., under a contract which contained definite guarantees as to plant performance.

This large plant, which is illustrated in the accompanying views, was erected in 1934. During its final test in November and December of that year, the plant was operated in excess of its guaranteed capacity on sulphate liquor alone, then entirely on pyrites, and finally on a combination of both sulphate liquor and pyrites. All guarantees of capacity and efficiency were fully met and the plant was promptly accepted. The Titanium Pigment Co. immediately authorized the design and construction of a second larger sulphate recovery unit at the new pigment plant it is building at Sayreville, N. J., which is now actively under construction and is expected to begin operations early this Spring.

At the St. Louis Plant, most of the equipment is housed in two large buildings of modern steel-frame construction. One building contains a dehydrator kiln, two rotary roasters, accessory equipment, and space for future similar equipment in event of general plant enlargement. The other building contains the main acid-plant equipment, such as catalytic converters, heat exchangers, centrifugal exhausters, and a central control room.

Equipment which is unaffected by climatic conditions, such as the gas washing towers, acid absorption towers, coolers, etc., is located outdoors adjacent to the buildings and arranged to minimize the length of connecting flues and pipings. The buildings are provided with overhead traveling cranes for handling heavy pieces of equipment.

The economic aspects of the process are naturally of major importance to steel mill managements considering its adoption as a solution of pickle liquor problems. The obvious advantage of the process, aside from its nuisance elimination value, is that it converts a waste product into fresh, strong sulphuric acid which can be used for additional pickling operations and does this efficiently without fumes, waste or other nuisances.

The contact acid process using dehydrated sulphate is somewhat similar to that using pyrites ore, differing principally in requiring the addition of a heating and reducing agent to the raw material. This agent is preferably pulverized coal of the cheaper grades but pyrites can be mixed with the sulphate, thus utilizing the heating value of pyrites to decrease the quantity of coal required while at the same time it also produces additional sulphur dioxide.

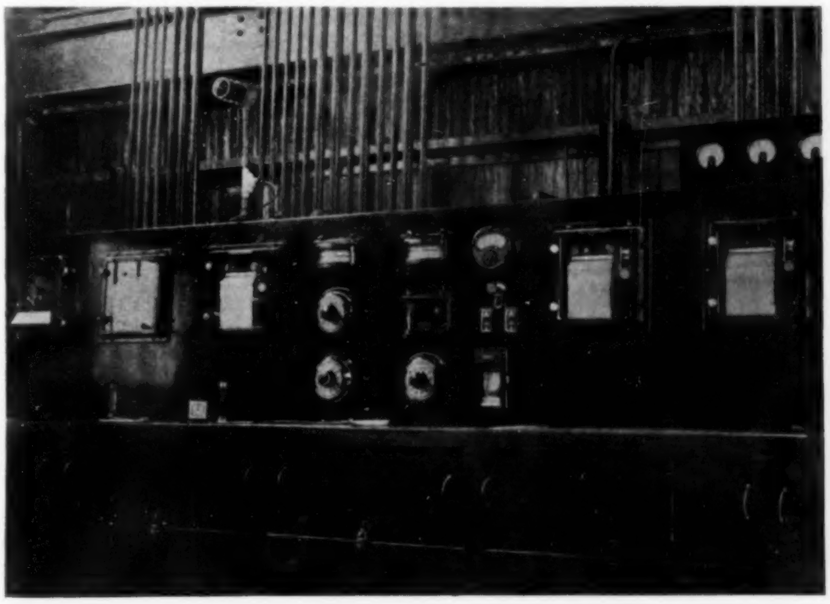
When dehydrated sulphate is roasted, the only raw material cost is that of the pulverized coal, plus the cost of collecting and evaporating the waste pickle liquor. This follows because the liquor itself ordinarily has no value owing to the lack of a market for any large quantities of ferrous sulphate. The cost of evaporating the pickle liquor depends on its dilution and the availability of cheap fuel. These factors differ for each situation, but it is self-evident that the more concentrated the liquor, the less the cost of converting it into acid. Also, if any waste heat is available for preconcentrating the sulphate liquor before it is delivered to the dehydrator, the acid production costs can be correspondingly decreased.

Since the iron oxide produced in the rotary roaster can either be sintered cheaply to produce an ore suitable for use in blast furnaces, or marketed as a red pigment, thus reducing the net cost of acid production, obviously, pickling liquors of normal concentration can be used for the production of sulphuric acid more cheaply than any other raw material available to a steel mill.

Since acid plant operation is necessarily continuous and to a great extent semi-automatic, with materials handled mechanically, large scale production is cheaper than operation of small plants. The initial investment per unit of capacity is also greater for a small plant than for a large installation. However, this new process may also be utilized to solve the disposal problem of small pickling liquor producers by roasting sulphate produced at scattered small dehydrating plants in centrally located acid plants.

The process used in this Chemico plant contains many novel features which have been covered in patent applications, already allowed wholly or in part in many cases, in the United States and principal foreign industrial countries. Many other features of the plant are already covered in patents owned by the Chemical Construction Corp. or its affiliated companies.

Part of control panel in contact acid plant of Titanium Pigment Co. at St. Louis



Fermentation as a Factor in Producing Organic Acids for Chemical Industry

By H. T. HERRICK and O. E. MAY
*Color and Farm Waste Division,
U. S. Bureau of Chemistry and Soils,
Washington, D. C.*

ORGANIC acids to supplement natural sources are produced industrially either biochemically by the action of micro-organisms, or by some of the well-known applications of chemical synthesis. To present a brief summary of the methods of manufacture of the more important individual compounds is the purpose of this article.

Citric acid has been synthesized in the laboratory, but it can be manufactured much more simply in other ways. At one time the Sicilian citrus industry was the chief producer of natural citric acid, and more recently the California citrus industry and the Hawaiian pineapple industry have also entered this field. These domestic fruit sources continue as a surplus disposal project, and also for the needs of consumers desiring an acid from fruit, but at present the most important process for the manufacture of citric acid utilizes the action of molds on sucrose solutions. This method first made its industrial appearance about 1927, and is based on work done in the Department of Agriculture about ten years previous to that time. The reaction is not a new one, having been discovered in Germany in 1890, but the present industrial installation is the first to operate successfully. Citric acid produced in this country has practically supplanted the former importations of the Italian product; in fact, American fermentation citric acid has even been exported to Europe in large quantities.

It is also reported that citric acid is now being manufactured by the fermentation of blackstrap molasses. If true, the advantage of a cheap raw material has been added to those already possessed by this process. It is unlikely that the mold fermentation process for the manufacture of citric acid will be displaced by any purely chemical development.

Production of tartaric acid has never been authoritatively reported in appreciable quantities as the result of micro-organic action. The present method of manufacture makes use of argols, the crude cream of tartar from the wine industry of France and elsewhere. As argols are a waste material with little other value, the price of tartaric acid must depend largely on the supply of the raw material. As long as the available amount of argols is far above that needed for the production of tartaric acid, the price for the raw material will undoubtedly remain within its present range.

For this reason, and also because tartaric acid is a 4-carbon acid, difficult to produce in reasonable yields from any of the commoner 6 or 12-carbon sugars, it is not believed that the manufacturers of tartaric acid by the present methods will ever have to face biochemical competition, although German patents describe a process for the production of this acid from dextrose by the action of hydrogen peroxide in the presence of oxidases and peroxidases of vegetable origin. Certain purely chemical methods for the synthesis of tartaric acid have also been discussed from time to time, but none of these proposals has as yet assumed industrial importance. New uses for tartaric acid, causing a demand for it or for its derivatives which would exceed the production possible from a limited quantity of argols might easily change this picture.

Acetic acid was first manufactured industrially by wood distillation, and the amount available was limited by the demand for wood charcoal. The acid produced in this way was first sold as calcium acetate and later as acetic acid recovered directly from pyroligneous acid. When the industrial demand for acetic acid began to exceed the amount produced by the wood distillation industry, it became necessary to seek other sources or means of production. Two methods were open, the biochemical and the synthetic. Both are now in use, but the fermentation process comprising the bacterial oxidation of alcohol has been outdistanced by the chemical. In the latter the acid is made available as glacial acetic acid or the anhydride, while the former produces acetic acid in a very dilute form, which is suitable for the manufacture of certain derivatives such as ethyl acetate. The Langwell patents for the production of acetic acid and other materials by the thermophilic fermentation of cellulosic materials have also received industrial consideration, but it is not believed that these are in operation at the present time.

From the inception of the industry the raw materials for lactic acid production have been carbohydrates, such as starch or glucose. Since the lactic acid bacteria work only on some of the simpler sugars, a preliminary hydrolysis is needed where starch is the starting point. More recently a process utilizing crude whey from the dairy industry has made itself an important factor as a source of lactic acid. Since crude whey was formerly a waste material, its conversion into the basis for a new byproduct industry is an important development which may change conditions in the lactic acid field. While several chemical methods for the production of lactic

acid are known, they are not important industrial factors at the present time.

There are three ways in which gluconic acid may be produced. In the first, dextrose is oxidized by a hypochlorite solution. In the second, calcium gluconate is produced by the electrolysis of a sugar solution containing a certain amount of a bromide. By the third method, the free acid may also be produced, either by the action of molds or some other organism, such as one of the oxidizing bacteria, on dextrose solutions.

Each process has its advantages. The deciding factor is likely to be the development of uses for the acid itself as well as its calcium salt, for gluconic acid may be recovered directly from the fermented sugar solutions without passing through the calcium salt. The significance of this factor lies in the establishment of possible uses for gluconic acid itself. At the present-time the chief outlet is in the form of the calcium salt, which finds an ever-increasing therapeutic application. The free acid, on the other hand, has not found any extended use. Should it, or one of its lactones, recovered directly from the fermentation liquor containing the acid as such, find some extended industrial application, a process yielding the acid itself might be considered more desirable than one which results in calcium gluconate. The development of a fermentation process which would utilize a cruder raw material might also swing the scale in favor of the biochemical methods.

Other organic acids, such as formic, malic, fumaric, oxalic,* succinic, butyric, propionic, and gallic, may be made either chemically or by fermentation. In the case of the first six, the chemical method is the one receiving present industrial preference, though promising fermentation methods exist for the preparation of butyric acid. Both methods find industrial application in the manufacture of gallic and propionic acids. In contrast with this group are maleic acid and tartaric acid, already mentioned, which are obtained only from chemical sources and not by fermentation.

Certain other acids, such as kojic, have only a laboratory importance at the present time, but if they ever assume industrial significance, it is likely that the fermentation method will be employed in their production. Kojic acid, which is little known, is a gamma pyrone produced by the action of a variety of *Aspergillus* on dextrose solutions. Its structure offers interesting possibilities to the research chemist, and it is hoped that some industrial use for it may be developed.

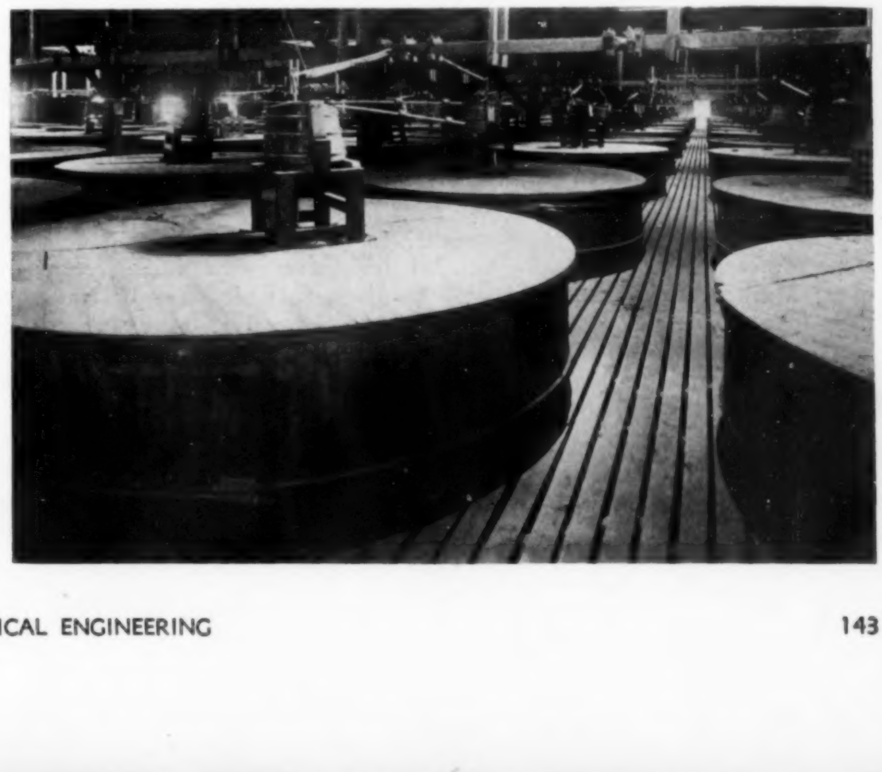
Factors in Inter-Process Competition

What are the deciding factors which have led to the adoption of one or more methods for the production of these organic acids? They vary with the acid concerned. Where more than one method is applicable, the choice is governed either by the complexity of the desired product, the availability of the raw material, or the use to which the finished material is to be put. If the molecule is reasonably complex, and a micro-organism can be found which will do the work in a satisfactory manner, it is probably cheaper to use this method rather than one of the more drastic chemical processes. If the structure of the acid is such that simple chemical reactions may be employed in its synthesis, it is better to avoid the delays and biological difficulties of a biochemical process, which frequently entails large capital cost per unit of product. Finally, if the choice of a method turns on the cost of a raw material, and the latter be a byproduct adapted for one use only, then the method employing the byproduct has the advantage, as long as an adequate supply of raw material is available.

In general, it would appear that the future field of fermentation chemistry lies along the line of the production of new organic acids of the type exemplified by kojic acid and other complex compounds, such as those reported by Raistrick in his "Studies in the Biochemistry of Micro-organisms" (*Phil. Trans. Royal Soc., London,* Series B, Vol. 220, pages 1-367). Such a development seems more to be expected than one which would lead to the encroachment of biochemical methods on the territory now occupied by satisfactory chemical processes for known acids. This seems especially true when one considers the modern trend toward the replacement of fermentation processes by chemical syntheses dependent on the present-day availability of certain chemical raw materials.

World's Largest Plant for the Production of Acetic Acid by Fermentation Process

Here in this huge plant of the U. S. Industrial Chemical Co., at Curtis Bay, Md., ethyl alcohol is converted into acetic acid by a unique process. The tubs on top of the large wooden tanks contain the alcohol which is distributed uniformly by revolving arms beneath the tank covers. This alcohol trickles over beechwood shavings, with which the vats are packed. Impregnated on these shavings are the bacteria, which with the air entering through the bottom of the vats, are responsible for converting the alcohol to dilute acetic acid. The entire output of this acid, which is practically chemically pure, is used in the production of acetate esters.



Materials Recommended for Oil Refinery Pumps

By A. E. HARNSBERGER
The Pure Oil Co., Chicago, Ill.

PRACTICALLY every step in the refining of oil involves some form of pumping machinery, the selection of which involves careful consideration of operating conditions under which the particular pump must operate. The four most important considerations are temperature, pressure, corrosion, and abrasion or wear. Consideration of temperature may be divided into three parts: (1) Extremely low temperatures, on the order of —50 deg. F.; (2) temperatures at atmospheric conditions or slightly above; (3) temperatures from 200 to 900 deg. F. Pressures fall into two groups, pressures reached by ordinary trade pumps, on the order of 200 lb. per sq.in., and extreme pressures up to 2,000 lb. Non-corrosive oils can be treated very differently from corrosive oils. Under the latter falls corrosion in the presence of water, which will occur up to 250 deg. F. The second type of corrosion occurs in high-temperature pumping equipment, with temperatures from 450 to 900 deg. F., largely caused by sulphur compounds. There are also other corrosive conditions met in refinery operations, particularly in the handling of acids, acid sludges, and other specialized processes, but these problems, although difficult to cope with, are not a major factor in refinery operations. Abrasion is a factor to contend with in handling certain hot oils containing coke or other impurities or in chemical processes in the handling of slurries made up of fullers earth, copper oxide, or the like. Wear occurs on parts in sliding contact.

Pump builders have made great progress in this field during the last ten years; pumps are now made of materials permitting operations which some years ago would have been thought impossible. For convenience the pumps used may be arranged in the following classes: (1) General service pumps; (2) pumps for distillation and cracking equipment handling oils up to 200 deg. F.; (3) up to 900 deg. F.; (4) pumps for gas absorption plants; (5) pumps for sludge acids; (6) pumps for treating processes.

For reciprocating pumps for general service the preference is toward iron fitted equipment; with cast iron or semi-steel for fluid ends up to 700 lb., and cast or forged steel for higher pressures. Iron packing rings give best results, and liners are mostly cast iron with some preference for Meehanite and Ni-Resist for sour oils. More attention must probably be given to wear than to corrosion in the selection of valves and valve seats. A light-weight stainless valve of the Durabla type will give good results, and a composition valve such as a Bakelite impregnated canvas disk on an iron or nickel-iron seat is also recommended, and iron or Ni-Resist wing guided valves on hardened steel seats are very satisfactory. Carburized and heat-treated steel gives good service for fluid and piston rods, with 13 per cent chromium steel for pumps exposed to the weather.

Cast iron or semi-steel is also satisfactory for cold service centrifugal pump casings up to 500 lb.; from 500 to 1,000 lb. 1 per cent nickel cast iron should be used, for higher pressures cast or forged steel. Impellers and rings are generally of cast iron. For shaft sleeves surface hardened steel gives good service, with chromium steels under corrosive conditions. Rotary pumps are also usually of iron and steel construction, hardened steel or chromium steels being used for shafts and rotors.

Pumps in service up to 200 deg. F. fall into the three classes, charging pumps, product pumps, and reflux pumps. For cold charging pumps of all types the materials used are practically the same as for the general service pumps; the same is to a large extent the case with reciprocating reflux pumps for light oil fractions. However, for fluid piston packings the latter often use Bakelite sectional rings or hardened iron liners. The rods on these pumps also give much trouble. Porcelain-coated mild steel, chromium plated rods, and rods built up with stainless steel by the spray process have shown from three to six months' service. Fair results have been obtained with 13 per cent chromium steel, and under most severe conditions KA_2S is recommended.

Centrifugal Pumps

Centrifugal reflux pumps for light oil fractions employ cast iron or semi-steel for casings and impellers except under severe corrosive conditions when bronze is used. Monel, bronze, Ni-Resist, Stellited steel, 13 per cent chrome steel and many other materials are being used for casing wearing rings, while no ideal material has been found for shaft sleeves. These are sometimes made from hard, acid-resistant bronze, and where corrosion is not too severe, from various types of hardened steels. A 13 per cent chrome steel gives fair service.

Many factors must be considered in handling hot refinery oils. These become more or less corrosive when the temperature exceeds 450 deg. F., due to the presence of sulphur compounds. Depending on the process the oil will deposit more or less coke which will tend to affect efficiency and capacity and which also causes more rapid wear. For reciprocating hot-oil pumps cast iron, semi-steel, and forged steel may be used up to 400 deg. F. with a pressure limitation of about 500 lb. at this temperature. High-test cast iron may be used for 450 deg. C. up to 600 lb. For higher temperatures and pressures steel castings are recommended up to 900 deg. F. and 1,000 lb. pressure. For the combination of the highest temperatures and pressures forged steel is desirable not only from a safety standpoint, but because of reduced cost due to the uniformity and dependability of

Abstract from paper presented at the annual meeting of American Institute of Mining and Metallurgical Engineers, Feb. 20, 1935.

this material. If the oil is particularly corrosive an alloy steel is recommended. Experience shows that a chromium content of not more than 6 per cent is needed.

A close-grained cast iron will give fair service for liners where abrasion and corrosion are not excessive. Meehanite gives better service than cast iron, and Ferrodur, centrifugally cast, has shown excellent results. Ni-Resist has also been found a good material. For temperatures above 600 deg. F. low-expansion high-alloy nickel cast irons should be used in preference to standard Ni-Resist. Centrifugally cast liners with up to 22 per cent chromium have been produced for the most severe conditions of corrosion and erosion. For packings cast iron rings are commonly used, but a hardened material such as chrome-nickel iron or Meehanite gives better service.

Materials for piston rods and plungers must not be too brittle. Among materials used for this purpose are various types of hardened steels, cast carbon steel, and low-carbon rods metallized with high-carbon steel. Under corrosive conditions a 13 per cent chromium steel may be used. Cast iron is used for valves and valve seats under low pressure and temperature conditions and cast steel for higher temperatures and pressures. Forged or cast 13 per cent chromium steel should be used for corrosive oil with much carbon.

All materials used in hot-oil centrifugal pumps should have the same coefficient of expansion. Outer casings are made of cast iron semi-steel, cast and forged steel. Generally the temperature and pressure limitations for these materials given under reciprocating hot-oil pumps can be somewhat exceeded, as shock is eliminated. For very corrosive oils alloy steels are recommended. A 4 to 6 per cent chromium alloy with 0.5 per cent molybdenum has proved highly satisfactory. Cast low-carbon, heat-treated steel can be used for inner casings; however, cast 4 to 6 per cent chromium alloy steel is preferable because it will resist corrosion and will accumulate coke at a slower rate than plain carbon steel.

Chromium Steels Widely Used

On non-corrosive oils the impellers may be used of semi-steel or low-carbon steel, up to 900 deg. F. Steel with 11 to 13 per cent chromium is widely used under corrosive conditions, also KA_2S and 25 per cent chrome, 12 per cent nickel steel. Impellers made of such chromium steels show practically no wear after many years' service. The same materials are also used for casing wearing rings.

Stellited low-carbon steel shaft sleeves have been found satisfactory where corrosion is not severe. Nitrided shaft sleeves last from four to 24 months. Under severe conditions good results have been obtained with 25-12 chromium-nickel steel, not Stellited.

Pumps used in gas absorption plants are not subject to extreme temperatures or pressures, 300 lb. and 400 deg. F. being the maximum. The materials used in these pumps are subject to the action of free sulphur and various sulphur compounds. Absorption plant pumps handling lean oil can be equipped in about the same manner as the general service pumps. If the oil is hot, the problems are about the same as for the pumps included under (3), used for oil up to 900 deg. F. Generally the resistance to wear is the primary consideration.

Reciprocating pumps handling light fractions are generally equipped with cast iron liners. Ni-Resist will more than double the service life. Cast iron, semi-steel, and low carbon steel are used for fluid ends. For higher pressures a close-grained cast iron with 1 per cent nickel is recommended, and for severe corrosive conditions Ni-Resist. Disk valves of Bakelite variety operating on iron seats will give good service; Durabla stainless valves on iron seats are also very satisfactory. Three-piece Bakelite rings operating on iron liners are the best piston packing, although cast-iron rings are in most general use. For piston rods a 13 per cent chromium steel or KA_2S steel is recommended.

Pumps for Absorption Plants

Centrifugal pumps for absorption plants are equipped with casings of cast iron, semi-steel, and low-carbon steel. Cast iron and semi-steel will generally also give good service for impellers. If the oil is moderately corrosive Ni-Resist should be used, filled with 13 per cent chromium Stellited wearing rings. These show no corrosion after three years' service. For less corrosive conditions a leaded bronze, fitted with Stellited iron rings may be used. Casing wearing rings and shaft sleeves of case-hardened steel or nickel-iron rings are used where corrosion is not severe, otherwise Ni-Resist or 13 per cent chromium steel is recommended.

Most refineries have the problem of disposing of sludge acid. Sludge from light oil is of low viscosity and is easily handled at ordinary temperatures. Sludge from lubricating oils, however, is very viscous and contains much coke. It is usually handled at temperatures from 100 to 220 deg. F., and pressures from 25 to 150 lb. Centrifugal acid pumps are strictly limited to sludges of low viscosity. Duriron is satisfactory where no strain can take place. Acid resistant bronze gives fair service on all parts, and Monel metal is equal with or superior to bronze.

Acid-resistant bronze or red brass is usually employed for liners and fluid ends of reciprocating acid pumps. Bronze and Monel metal are recommended for piston, rings, rods, valves and valve seats; Meehanite is occasionally specified for pistons and rings.

Rotary acid pumps usually have acid resistant bronze cases and shafts and rotors of either the same material or Monel metal. Sometimes the combination of acid resistant bronze rotors and a Tempalloy shaft is incorporated. Other pumps have been built with hard lead cases with Illium rotors and shafts.

Pumps used in continuous treaters generally handle a mixture of oil and concentrated sulphuric acid or caustic soda of varying strengths. In general the recommendations outlined for general service pumps may be followed with the exception that Bakelite valves and bronze parts should be avoided in the presence of caustic.

In reviewing the material requirements of refinery pumps, every definite need of alloy steel and iron parts is disclosed. The only thing that restricts their use is their high cost, and this high cost must be attributed to lack of volume of any one alloy. Pump manufacturers should therefore survey the chemical industry to determine whether the majority of conditions may not be met by a few alloys that can be produced in larger quantity at lower costs.

Looking Into the Future of Paint and Varnish Industry

EDITORIAL STAFF REPORT

THE Philadelphia regional meeting of the American Society for Testing Materials was held March 6. A feature of the meeting was the symposium on paints and paint materials.

H. A. Gardner of the Institute of Paint and Varnish Research, Washington, opened the meeting with an interesting discussion looking into the future of many phases of the paint and varnish industry. While we are largely dependent upon plant life for the drying oils used in paint, he stated that it is probable that in the future we shall be using oils produced by the metamorphosis of crude petroleum. For instance, we have already developed the fact that the chlorination and dechlorination of a straight chain hydrocarbon will result in the introduction of double linkages, and that the product will dry in an hour or two. However, refining methods must be developed in order to remove traces of finely divided colloidal carbon which stain such oils and plasticizers, for such oils must be developed to give them greater distensibility. The use of acetylene compounds for the production of drying oils will also show greater strides in years to come.

New colors will be made from older ones. For instance, carbon black may some day be produced as an isotope or with a greater number of atoms in the molecule, so that its color will be red or green or blue instead of black. This may not be as impossible as it would appear. Changes in physical structure may make profound changes in its light absorption and reflecting properties. There will be a trend toward colors of greater reduced particle size, increased strength, and better dispersing properties.

Titanium, which was once considered a rare element, is now employed to a tremendous extent in the paint industry. It is conceivable that many other elements will enter into this field, since minerals now considered rather scarce and expensive are occasionally coming to light in large deposits. The use of zirconium, selenium and other elements offers attractive possibilities in this direction.

One of the important economies to be obtained through the use of paint is that of protecting iron, steel and other metals from corrosion. Although the present tendency is to produce alloys that do not rust under ordinary conditions, these alloys are usually expensive and hence would probably not replace ordinary structural steel to any great extent. Moreover, many light alloys containing aluminum, magnesium and similar metals, are subject to weather etching, with the formation of white oxides which gray with the accumulation of dust upon the rough etched surface. Some of these alloys are quite susceptible to corrosion embrittlement if they are not protected with coatings. It is apparent, therefore, that paint chemists will be expected to continue their work in checking the enormous toll which corrosion places upon industry.

A gradual return to the use of nitrocellulose in quick-drying coatings may be predicted. Some recent experimental work indicated the possibilities of replacing organic solvents with certain types of aqueous dispersions. With such aqueous dispersions, it is possible that much higher total solid contents will be obtained, thus overcoming one of the principal objections to lacquer. Aqueous dispersions will also open up many new possibilities, such as the application of such coatings to wet surfaces, with assurance of good adhesion. Lacquer emulsions might also be of interest from a safety standpoint, because of the marked reduction in flammability due to the lowering of the vapor pressure. Emulsification with protein-aqueous material, and the use of some of the newly developed plasticizers, may be helpful in this direction. Moreover, it is probable that some of the newer types of cellulose compounds will be used more extensively in quick drying finishers.

Certain of the newer mixed esters or ethers of cellulose, used alone or in combination with some of the older ones, will doubtless result in materials which will have a wide field of usefulness. Some of them will have a much greater degree of solubility so that they may be employed with such solvents as are relatively inexpensive and nontoxic.

Rubber in Paints of the Future

Rubber has never been used to any great extent in paint because of its rapid breakdown under ultraviolet light. However, because of the possibilities of growing such tremendous quantities of rubber in the East Indies at extremely low cost, it is believed that rubber may form a base of a great many paints in the future. For instance, chlorinated rubber and depolymerized rubber compounds have been developed recently. These materials may be dissolved to fairly high concentrations in volatile liquids to produce quick drying coatings that are extremely resistant to alkalis and acids.

Titanium pigments in the paint industry were discussed by I. D. Hagar, eastern sales manager, Titanium Pigments Co. During the period of the depression there has not been a single year in which the sales of titanium pigments have failed to show an increase over the preceding year, except 1932. In that year, tonnage sales just about equalled those of 1931. In all other years, the increases have been from 20 to 40 per cent.

The outstanding characteristics of the titanium pigments is a hiding power greater than that of the other opaque white pigments commonly in use. It is generally recognized that titanium pigments possess concentrated hiding power to a far greater extent than was dreamed of a few years ago, and this property alone has opened many possibilities in formulations.

Under a rather narrow classification the lead pigments might be considered as limited to basic carbonate white lead, red lead, white basic lead sulphate, blue basic lead sulphate and, to a certain extent, leaded zinc oxide. These pigments were covered in a paper by R. L. Hallett and C. H. Rose, chemists with the National Lead Co. The authors called attention to the properties of these pigments and to the fact that "almost from the beginning of civilization some of the lead pigments, particularly basic carbonate white lead, have played an important part in paint and painting work."

Zinc Pigments

The zinc pigments were covered in a contribution by E. H. Bruce, general manager of the technical department of the New Jersey Zinc Co. The zinc pigments are used for their chemical properties as well as their optical properties. Since they are available in both reactive and non-reactive form, they may be utilized wholly because of their chemical reactivity (colloidal zinc oxide), for both their chemical and optical properties (zinc oxide), or in forms that are sufficiently non-reactive that optical properties must be the major consideration in their use, as in the case of zinc sulphide pigments. It is this combination of optical and chemical characteristics of zinc pigments that has given them their wide range of usefulness.

Lacquer solvents and volatile thinners were discussed by R. M. Carter, research chemist for the U. S. Industrial Alcohol Co. The commonly used lacquer solvents fall into three general classes: (1) alcohols, (2) esters, and (3) ketones. There are also numerous solvents in general use which are of the "two-type" class, that is, they combine in one substance the properties of two different classes. For example, ethyl lactate contains both an ester and an alcohol group, while Cellosolve acetate has both an ester and an ether group. The esters and ketones are active solvents, while the alcohols are latent solvents for nitrocellulose.

The ideal solvent should meet the following criteria: (1) It should be a solvent for both the nitrocellulose and the resin; (2) It should be non-hygroscopic; (3) It should evaporate rapidly at the beginning and slowly at the end; (4) It should produce solutions of low viscosity with fairly high concentrations of nitrocellulose; (5) It should have no objectionable odor; (6) It should be stable, and have no untoward action on nitrocotton or pigment; (7) It should stand dilution with hydrocarbon diluent; (8) It should be cheap; (9) It should be readily available.

Since no one solvent combines all the desirable properties, a mixture must be used. In the proper selection and proportioning of the ingredients of a solvent lies the art of the lacquer technologist. The selection of the proper nitrocellulose and resin may be much easier than the formulation of the proper solvent.

A contribution on natural and synthetic resins was made to the program by W. T. Pearce of the Resinous Products and Chemical Co. After discussing the properties of each important resin of both groups, the author draws certain interesting conclusions. The use of pure chemical bodies and precision of manufacture give to synthetic resins of all types, a degree of uniformity and versatility of properties not found in natural resins. This has led to more uniform finishes and coatings with characteristics which cannot be secured with natural resins. For some purposes, many believe the natural varieties are better and much more economical.

Resins have higher refractive indices than oils, and thus give films of higher luster. They also form hard brittle films. Thus resins are used in varnishes to impart high luster and hardness. The color of the processed resin must be pale to be suitable for light-colored varnishes, and dark where dark-colored finishes are desired. The characteristics of the varnish are dependent upon the methods of manufacture, and the properties of each resin, oil, drier and thinner used. The ratio of resin to oil is the chief factor in determining the purposes for which the varnish is best suited—such as for rubbing, floor, interior or exterior applications.

Whether the characteristics of the resin are satisfactorily imparted to the varnish depends also upon the oil. Fossil resins give the best results with linseed oil, while rosin is relatively unsatisfactory with the same oil. On the other hand, rosin is a very valuable resin when used with tung oil. In general, phenol-formaldehyde resins are well suited for use with tung oil, their effect upon linseed oil varying widely among individual resins. For this reason it is difficult to make general statements about the varnish-making qualities of a type of resin because of the effects due to the type of oil and to the methods and skill of the manufacturer.

Chemical Colors

A. F. Brown, general manager, Imperial Color Works, presented a paper on chemical colors. He stated that chemical colors can be roughly divided into two classes, inorganic and organic, and the organic colors can be sub-divided into the following types: (1) precipitation of acid dyestuffs by such precipitants as barium chloride, calcium chloride, lead acetate, and so forth; (2) precipitation of basic dyestuffs with tannic acid, tannic acid and tartar emetic, or "synthetic tans," precipitation of basic dyestuffs with phospho tungstic acid or phospho molybdic acid; (3) diazotization of an amino compound and coupling with a second component (azo pigments or "ice colors"). He then followed with a discussion of each of the most important colors.

Other papers on the program were: Preparation, use and abuse of specifications for paint materials, by P. H. Walker; protective and decorative coatings for railway passenger car equipment, by A. M. Johnsen; paint testing, by C. D. Holley; varnish testing, by W. R. Fuller; lacquer testing, by H. E. Eastlack; drying oils, by S. O. Sorensen; mineral pigments, by J. W. Ayers, director of research, C. K. Williams and Co.; and turpentine and petroleum distillates as thinners for varnish and paint, by J. M. Schantz, naval stores department, Hercules Powder Co.

Corrosion Features Meeting of Electrochemists

EDITORIAL STAFF REPORT

THE ANNUAL MEETING of the Electrochemical Society was held in New Orleans, March 21-23. A feature of the meeting was the visit to the new development of the Freeport Sulphur Co. at Grande Ecaille.

One of the most interesting technical sessions was on the subject of corrosion. In his contribution on voltaic couples and corrosion Prof. Oliver P. Watts of the department of chemical engineering at the University of Wisconsin commented that progress in the natural sciences has been greatly aided by classification of the phenomena of each science, but heretofore this aid has been notably lacking in studying the host of individual cases encountered in the corrosion of metals in aqueous solutions. To supply this lack the author has proposed a classification into which he believes every case of the corrosion of metals in aqueous solutions can be fitted. Type 1—Corrosion without displacement of anything from the corroding solution, e.g., the dissolving of iron or copper by a solution of ferric chloride. Type 2—Corrosion by displacement of a metal, e.g., the dissolving of iron by a solution of copper sulphate. Type 3—Corrosion by visible displacement of hydrogen, e.g., the dissolving of commercial zinc by dilute sulphuric acid. Type 4—Corrosion by invisible displacement of hydrogen, followed by its physical or chemical removal, e.g., the corrosion of iron by sea water or of copper by dilute sulphuric acid.

These four types of corrosion are not exclusive of each other, but the same piece of metal may be corroding by two or more of them simultaneously. When oxygen or an oxidizing agent is present in the solution, corrosion of type 3 is always accompanied by type 4, although the latter may contribute only a small percentage of the total corrosion, unless the solution is stirred.

The process of corrosion in voltaic couples does not, in the author's opinion, differ in its nature from the corrosion of a single metal. Except for type 1, in either case the metal enters solution only by displacing its equivalent of other cations.

In contending that the presence of voltaic couples is not necessary to corrosion, the author does not mean that voltaic couples and impurities in metals are without effect on corrosion. Far from it! Contact with another metal or introduction of impurities into the metal itself usually localizes corrosion, even if it does not increase its amount. Such contact or impurities may, with certain metals and electrolytes, change the process of corrosion from type 4 to type 3, thus greatly increasing the rate.

An unusual cause of corrosion was reported by Prof. E. Newbery of the physical chemical department at the University of Cape Town, South Africa. He investigated a case of severe corrosion in the brass pipe and driving rod of a deep well pulsometer pump. It was found that the corrosion was caused by motor-electrolytic currents generated by the rapid motion of an electrolyte (diluted sea water) over the surface of the rod and interior of the pipe. The outer surface of the pipe, being in contact with the undisturbed electrolyte, formed the cathode of the motor-electrolytic cell and was quite uncorroded. It was suggested that this source of corrosion trouble has not been sufficiently recognized in the past.

An Unusual Cause of Corrosion

A potential difference of the order of 20 mv. between the inside and the outside of the brass pipe acting for 18 months is quite sufficient to account for the corrosion effects observed, especially as polarization is largely prevented by the mechanical disturbance of the electrolyte, according to the author. The inside of the pipe in contact with rapidly moving electrolyte acts as anode, and the outside of the pipe in contact with comparatively undisturbed electrolyte forms the cathode. The top section of the pipe is not surrounded by electrolyte and the inner surface has therefore no cathode, with the result that this section is but little corroded. This suggests that the corrosion of the inner surface might have been greatly decreased by insulating the outside with a coating of some waterproof bituminous paint.

Such treatment would probably fail to protect the driving shaft since this seems to have been affected to a much greater extent by local currents induced by differences in speeds of the water at different points on the shaft. Near the guides, corrosion is very severe, but other parts are much less affected. These unaffected parts are local cathodes and it is unlikely that any insulating paint would remain long on this rod. It may be necessary, therefore, to use a corrosion-resisting rod for this driving shaft.

Solution rates of zinc electrodes in acid solutions were discussed by Prof. H. Mouquin and W. A. Steitz of New York University. The effect of externally imposed potentials on the rate of solution of zinc anodes in acids has been studied under controlled conditions. A minimum rate is observed which is substantially identical for acids of widely differing degrees of ionization. Electrostatic attraction is suggested as an important rate-controlling factor in these experiments.

Several papers were presented at the symposium on electroplating. The first of these concerned the determination of trivalent chromium in chromic acid and in chromium plating baths. It was offered by Hobart H.

Willard and Philena Young, professors of analytical chemistry at the University of Michigan and Wells College respectively.

Baths produced by combining zinc sulphate, zinc oxide, sulphuric acid, ammonium sulphate, and ammonium hydroxide were investigated to determine the range of compositions from which zinc metal may be electro-deposited by Raymond R. Rogers and Edgar Bloom, Jr., of the department of chemical engineering at Columbia University. This range is plotted by the authors on a ternary diagram using NH_4, SO_4, and Zn as the variables. And the effect of current density and temperature on the appearance of the deposits was also investigated.

Another contribution to the study of cyanide zinc plating baths using Al-Hg-Zn anodes was made by Prof. A. Kenneth Graham of the chemical engineering department at the University of Pennsylvania. From 1.0 to 0.56 N zinc cyanide baths containing from 3 to 7 oz. per gal. (22.5 to 52.5 g. per L.) sodium hydroxide were studied with respect to cathode efficiencies and character of deposits at 20, 40, and 60 amp. per sq.ft. (2.2, 4.4 and 6.6 amp. per dm^2) and 110 deg. F. Using Al-Hg-Zn anodes, excellent deposits were obtained at all current densities with bath compositions other than those which have previously been shown to give the most ideal anode behavior. The variation of cathode efficiency with time of plating, bath composition, solution concentration and current density was noted.

The electrolytic reduction of methyl *n*-propyl ketone to *n*-pentane was the first of two contributions on electrolytic reduction of organic compounds from the Engineering Experimental Station at the University of Illinois. This is a continuation of the study of the electrolytic reduction of aliphatic ketones which Prof. Sherlock Swann, Jr., and Jack Feldman began two years ago and of the general problem of electrolytic reduction of ketones reported upon in Bulletin No. 236 of the Engineering Experimental Station, University of Illinois. The optimum conditions for the electrolytic reduction of methyl *n*-propyl ketone to *n*-pentane at a cadmium cathode were reported in the preliminary paper. The present paper deals with the behavior of cathodes other than cadmium. It was found that cadmium, zinc, lead and mercury in the order named are the best cathodes for this reduction.

Electrolytic Reduction of Acetophenone

The electrolytic reduction of acetophenone was reported upon by Professor Swann and another one of his students, G. H. Nelson. The reduction in sulphuric acid solution was studied at cathodes of cadmium, tin, lead, mercury, aluminum, zinc, nickel, copper and iron. The main products of the reduction were acetophenone pinacone, bis (α-methyl)—benzol ether, and a resin of unknown constitution. The best yield of acetophenone pinacone was obtained at the lead cathode.

Notwithstanding the abundance of pH values in the literature, there is, yet, a lack of systematic data on solutions of substances in the alkaline range, especially for the high pH values. In engineering operations the regulation and the control of the pH in alkaline solutions is so necessary that there is a need for such data. Consequently an effort was made to secure systematic data on solutions of some typical substances. Prof. Samuel J. Kiehl and Russell D. Loucks of the chemical department at Columbia University reported a systematic study of the pH values of solutions of the sodium salts of phosphoric, boric and carbonic acids and sodium hydroxide. The results cover a wide variation of concentration at 30 deg. C. Some typical solutions of the various systems were studied at 60 deg. C. to indicate the change of pH with temperature. Except in the case of boric acid, the pH values are all lower at 60 deg. C. than they are at 30 deg. C. The pH of solutions of both disodium phosphate and sodium bicarbonate decreases with an increase of concentration for 0.05 M up to 0.5 M. There is a maximum for both in lower concentrations as the dilution approaches pure water (pH=7).

Detecting Electrode Reactions

The use of a modified Haring cell in detecting electrode reactions was reported by Prof. Robert Taft and Jesse E. Stareck of the chemical department at the University of Kansas.

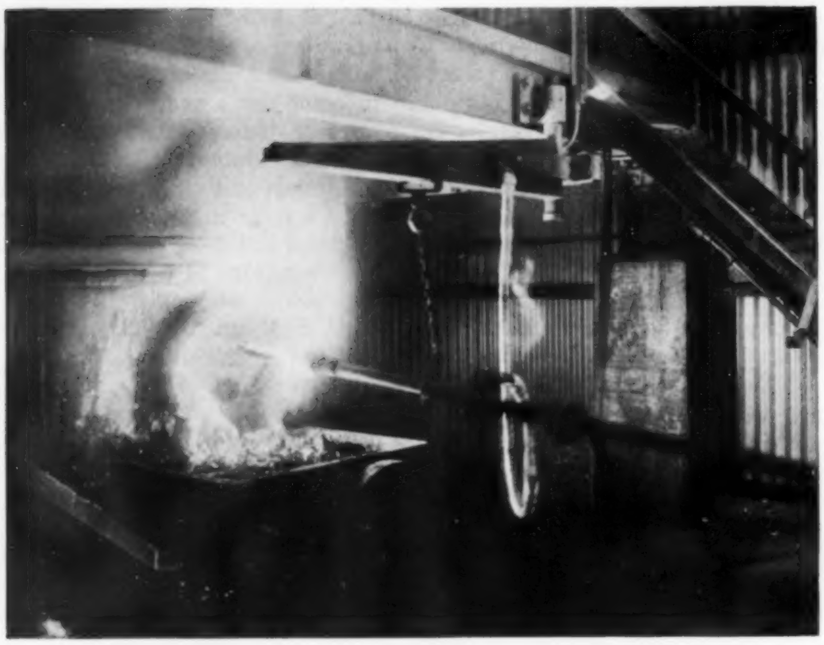
The Haring cell, devised primarily for the measurements of polarization and throwing power, offers a fourth possibility for detecting electrode reactions. This method possesses several advantages over the other methods, especially in connection with the deposition of metals under conditions which resemble more nearly those which are present in electroplating baths.

With the aid of a modified Haring cell, the deposition of silver from silver nitrate and from cyanide solutions was carefully studied. Starting out with extremely low current densities and voltages, these were gradually increased and every slight break in the volt-ampere curves repeatedly checked. Finally these breaks in the curves were interpreted by the authors and assigned to certain physical and/or chemical reactions. The cathode products detected were crystalline silver, silver hydride, and hydrogen; the anode products, silver peroxide and oxygen. The characteristics and properties of the silver hydride formed at the cathode were discussed at length.

E. W. Chambers, a student at the University of Melbourne at Victoria, Australia, contributed a paper on the reversible rectification in electrolytic rectifiers. Reverse rectification is known in rectifiers of the dry type. A somewhat familiar phenomenon has been found in electrolytic rectifiers; but with the difference that its extent and rate of variation can be controlled. It is also not limited to one voltage. It may be obtained by varying the relative immersed areas of two assymmetrically conducting electrodes in a suitable electrolyte. Unformed lead may be formed and charged and discharged by this means. The phenomenon is thought to be due to progressive loss of uni-lateral conductivity with increasing depth of immersion of whichever electrode is lowered into the solution.

The hydrogen overvoltage and the anodic behavior of tungsten in aqueous solutions of potassium hydroxide was the subject of a paper by Prof. M. de Kay Thompson and C. W. Rise, Jr., of the Massachusetts Institute of Technology.

The news of the New Orleans meeting, which will include the names of the newly elected officers, the abstracts of the technical papers and the discussion that followed their presentation will be reported in an early issue of *Chem. & Met.*



Small-Scale

Tapping the furnace; showing chill buggy and tapping electrode in working position

AS A RESULT of technical and economic disadvantages of small-scale operation, the carbide industry has generally been confined to a relatively few regions of extensive hydro-electric development. The decision of Cerro de Pasco Copper Corp. to manufacture carbide in Peru was, however, a logical consequence of the high cost of importing this material from foreign sources, and of the availability of surplus power which could be thus utilized. In view of the small tonnage involved, the design of a plant for this purpose presented unusual problems, a minimum capital expenditure and operation with little or no skilled supervision being obviously essential to the attainment of reasonable costs and fixed charges.

The Oroya smelter, 12,200 ft. above sea level and centrally situated with respect to the various mining properties of the corporation, was chosen as the site for the carbide plant, construction of which was started in November, 1932. With the exception of electrodes, all materials used were obtained from stock or salvage, and all new equipment required was fabricated in the local shops. After completion of the plant in June, 1933, a considerable time was devoted to a study of such phases of the operation as tended to give rise to difficulty, in the course of which a number of minor changes were made. Since the conclusion of this smoothing-out period, the plant has been operated entirely by native labor, with the aid of periodic inspection by the regular smelter staff.

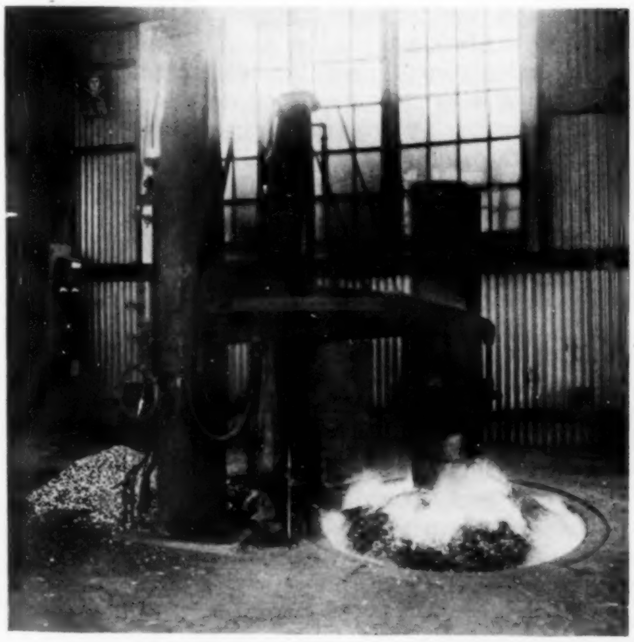
The carbide plant was located adjacent to the brick plant of the smelter, to permit utilization of some of the existing facilities in the brick plant crusher building, consisting of a jaw crusher, a set of rolls, and a bucket elevator for the preparation of raw materials. A two-way splitter was inserted in the elevator discharge, and a rotary screening unit for carbide materials was installed in the crusher building. Raw material storage was provided by two cylindrical steel silos which project through the rear wall of the carbide plant as shown in diagram.

Burnt lime is available as a regular brick-plant product, being made in two oil-fired, vertical shaft-type kilns. From the kilns it passes through the jaw crusher, rolls, and elevated to a screen which rejects fine material, the oversize from this screen going directly to the storage bin. As the limerock is quarried from a nearby re-precipitated deposit, the lime is of high purity, but undesirably friable. Since the fines produced by crushing can readily be utilized in other departments, however, no serious problem is presented. Some difficulty has been experienced in obtaining a satisfactory coke supply, as the regular metallurgical coke used at the smelter is of high-ash content, but by careful selection from locally available sources, considerable improvement has been made. The coke passes through the same crushing circuit as the lime, but an additional screen is used to limit the maximum size of the product, undersize from this screen going to the storage bin, while the oversize is returned to the rolls.

In the carbide plant building, which is of steel frame construction with corrugated-steel closure, coke and lime from the storage bins are weighed out on a charging floor which extends across the western half of the building, level with the top of the furnace. Provision has been made for two furnaces, only one of which is installed at present. The furnace shell which is roughly elliptical in plan with a tapered-in bottom, is constructed of ⅜-in. steel plate. It is lined with one course of firebrick at the sides and rammed carbon paste in the bottom, and rests upon an I-beam grillage. A ventilating hood, connected to a 4-ft. diameter stack extending through the roof, is placed directly over the furnace. An I-beam track and crawl carrying a 1-ton chain block is attached to the bottom of the hood, permitting new electrode sections to be hoisted through a hatch in the charge floor and placed in position on the furnace.

Production Of Carbide

By GUSTAVE REINBERG
Research Engineer
Cerro de Pasco Copper Corp.
New York, N. Y.

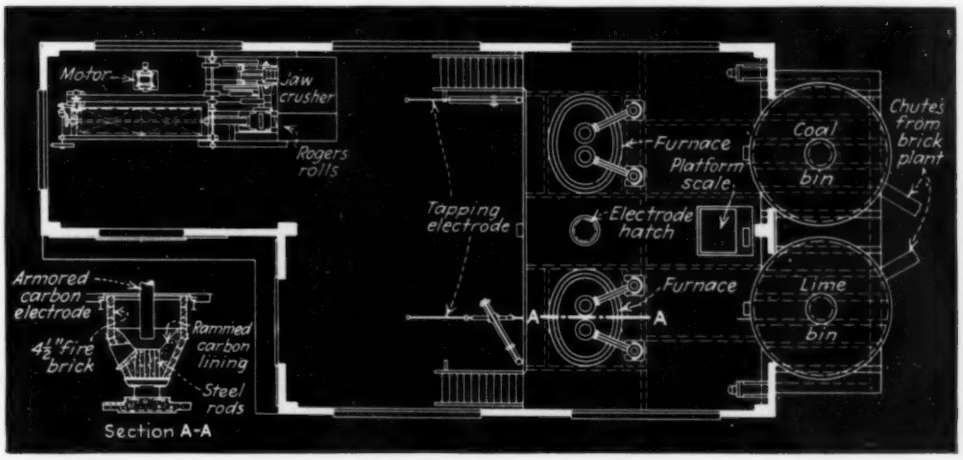


Charging floor, showing furnace top, electrode holders, control panel

The electrode holders comprise cylindrical bronze rods operating in cast iron guide pillars and carrying bracket arms which extend over the furnace and support the electrode clamps. Each clamp consists of three hollow bronze segments which are actuated by right-and-left sleeve nuts. The clamp segments, bracket arms, and guide rods are all water-cooled, heavy copper pipe cores being used in the current-carrying parts to provide the requisite electrical conductivity. Vertical motion is imparted to the guide rods by means of hydraulic cylinders beneath the charging floor, admission of water to the cylinders being controlled by solenoid valves. These valves are actuated by push-buttons on the furnace panel board, so that the position of the electrodes can be regulated from that point, as well as by emergency manual valves on the pillars. Provision is also made for operation of the solenoid valves from differential current relays, affording automatic control of the electrodes if desired.

Power is received over a 2,200-volt feeder from the smelter substation, which is about 1,800 ft. distant. Since it was expected that furnace transformers of the usual indoor type would ultimately be installed, the foundation under the storage bins was designed to serve as a transformer vault. For the initial installation, however, the purchase of a special transformer was avoided by adapting standard equipment which was already on hand to the purpose. Six regular distribution transformers, each rated 50 kva., 2,200 to 110 volts, were grouped to form a bank, all transformers being connected in parallel. A water cooling coil was placed in the top of each transformer tank, permitting safe operation at considerable overload. A special heavy current auto-transformer was built and placed across the secondary of the main bank, this unit being provided with several taps by means of which the voltage applied to the furnace could be adjusted. To control the inductive characteristics of the circuit, an oil-immersed tapped reactor, which was also locally built, was placed in series with the primary of the transformer bank.

The furnace is tapped by means of a 2-in. diameter graphite electrode mounted in a water-cooled clamp on the end of a long pipe handle, the entire assembly being supported by a small jib crane. Current is supplied to the tapping electrode by a special transformer built to furnish about 50 volts on open circuit, with sufficient inherent leakage reactance to limit the tapping cur-



Present capacity of plant 1.2-1.5 metric tons of carbide per day. One foreman and two helpers per shift

rent to a safe value. Standard oil circuit breakers are placed in the primaries of both the tapping transformer and the main furnace bank. A control panel placed in one corner of the furnace room carries a primary ammeter, two furnace voltmeters with pilot lights, the electrode control buttons, circuit breaker switches, an integrating watt-hour meter, and the necessary control and protective relays.

A cast-iron tapping pan mounted on a two-wheeled buggy receives the carbide tapped from the furnace. When sufficiently cool, the resulting cakes are broken up with a sledge and fed to a 7x9-in. jaw crusher. A flight elevator, rotary trommel screen, and a small set of rolls, working in closed circuit, serve to complete the reduction of the carbide, the bulk of which is crushed to "grain" size (8 mm.) for use in miners' lamps. Lamp-size carbide is also used in the small portable generators which are employed for miscellaneous cutting and welding, and the relatively small quantity of coarse carbide required for the automatic generators used at the shops is obtained from a bypass gate in the chute leading to the rolls. Fines and dust produced by crushing are screened out of the product in the first section of the trommel, this material being returned to the furnace. For shipment of carbide to the mines, a number of semi-permanent containers were made up from old oil drums by fitting them with large screw-top covers, these drums being returned for refilling as long as they are in good condition. Machinery has also been installed for the fabrication of the conventional one-trip sheet-metal containers in the shops.

Design, construction, and initial operation of the carbide plant were in charge of the research department of the Cerro de Pasco Copper Corp., under the direction of T. E. Harper, Jr., and the writer. I am indebted to the management of the corporation for its kind permission to publish this account of the production of calcium carbide.

▼ ▼ ▼

Effects of Chemicals On Woods

THERE would appear to be national traditions behind the choice of woods for chemical vats, W. G. Campbell stated in a paper read before the chemical engineering group of the Society of Chemical Industry, at London, Dec. 14, 1934. It is probably safe to say that in Great Britain chemical engineers stand by pitch pine, with Douglas fir as a close second. In the United States, on the other hand, Louisiana gulf cypress has first choice. Prime qualities of all these woods make good tanks and the same may be said of teak and New Zealand kauri pine. What are the fundamental reasons underlying the choice of woods for vat making? Leaving aside such important questions as price, availability in the proper sizes and working qualities, it is generally admitted that anatomical structure is an important factor, as upon this the all-important factor of permeability is mainly dependent. Again, it has been claimed that certain minor constituents, like the resin in pitch pine, exert a protective effect on the fibers, for example against acids. This probably is an important factor, but it can be over-stressed. Experience has shown that pitch pine, which contains too much resin, does not make a good vat for use with hot liquids, since under the influence of heat the resin may ooze out of the wood with a resultant high degree of shrinkage.

There is another factor in the case which has come to light in the course of recent research, and this is the composition of the wood cell wall itself.

At this stage it should be emphasized that probably no wood will be found to give long service in contact with caustic alkalis, for the fundamental reason that these reagents attack all of the major components as well as some minor constituents. To use caustic soda in a vat which has previously been used for acids is not to be recommended either, since it has been shown experimentally that even mild preliminary acid hydrolysis renders wood substance much more soluble in alkali than it would otherwise be. In general, softwoods, on account of their relatively low hemicellulose content, withstand alkalis better than hardwoods.

The pronounced oxidizing effect of concentrated nitric acid on wood is of course well known, but even in low concentrations this acid has also a pernicious effect, since it causes both oxidation and hydrolysis, resulting in the simultaneous breakdown of all of the major wood components.

As Loveless has pointed out, the main value of wood in chemical plant construction lies in its resistance to acid liquors such as sulphuric and hydrochloric acids and their acid salts. This is directly attributable to the fact that the lignin and α-cellulose of wood are very resistant to acids. To go one step further it may be said that, other things being equal, woods which have a high α-cellulose content, a high lignin content, and a low pentosan content will offer the best resistance to acids. This explains why certain hardwoods which have no redeeming structural characteristics in their favor cannot give long service in acid vats. It has already been mentioned that hardwoods as a rule have much higher pentosan contents than softwoods, but work at present in progress indicates that in this respect teak is an exception. For a hardwood it has a low pentosan content. It is also favored with high lignin and cellulose contents, so that when due allowance is made for the strength, structural characteristics, and the protective effect, if any, of minor constituents, the reliability of teak for certain purposes finds a more complete explanation than has hitherto been available. This aspect of the study of acid resistance has been applied to other woods, and the results will be published in due course.

For the present the position might be summed up by saying that it is more than ordinarily unusual to find a wood that is imbued with all of the advantageous characteristics of the examples cited, and that is why it is difficult to find substitutes for those few species which long experience has shown to be the best woods to use in chemical plants.

Varied Program Pleases Ceramists In Convention at Buffalo

EDITORIAL STAFF REPORT

ONE of Buffalo's typical winters in no wise chilled the enthusiasm of the unusually large group of ceramists and ceramic engineers who converged on the Windy City during the week of Feb. 17. This annual meeting, the American Ceramic Society's 37th, attracted an attendance of well over 800, the largest in years. With its well chosen program of nearly 150 papers, of social events and of plant visits, the convention was, in the opinion of every member questioned, one of the most successful the organization had ever held, and unquestionably the best since the onset of the depression.

As a result of the Society's elections, officers for 1935 were announced as follows: President, J. M. McKinley, North American Refractories Co., Cleveland; Vice-President, F. C. Flint, Hazel Atlas Glass Co., Washington, Pa.; Treasurer, H. B. Henderson, New Brighton, Pa.; and General Secretary, R. C. Purdy, Columbus, Ohio. F. H. Riddle, Champion Spark Plug Co., Detroit, was elected dean of Fellows; and A. S. Watts, Ohio State University, Columbus, associate dean. The newly elected trustees include P. D. Helser, General Refractories Co., New York City, and J. T. Littleton, Corning Glass Works, Corning, N. Y. It was decided that the 1936 annual meeting would be held in Columbus, Ohio.

A feature of the convention which should be highly recommended to other societies having a large number of divisions was the devotion of an entire day to two general sessions, one on the firing of ceramic ware and the other on color, design and decoration. In the first of these symposia J. B. Austin, U. S. Steel Corp., Kearny, N. J., discussed the objectives of firing in the light of the chemical reactions occurring during the process. J. A. Doyle, W. S. Rockwell Co., New York City, took up the fundamentals of firing, explaining the need for uniform exposure to permit uniform heat transfer and make possible uniform temperature. He emphasized the fact that, as in the case of heating of other products, no form of fuel or electricity has a monopoly on efficiency in ceramic firing.

It has long been known that kiln atmosphere has an extremely important effect on the ware fired, a factor that has become even more apparent in some of the work on electric kiln heating. Matt Mawhinney, Salem Engineering Co., Salem, Ohio, described means for providing the proper atmosphere in an electric kiln by moving air with a steam jet at certain stages in the firing. Use of a circulating atmosphere in the electric kiln has the advantage of making for greater temperature uniformity. Design and control features of small periodic electric kilns were discussed by E. J. Harris and B. A. Bovee, respectively of the Carborundum Co. and the Globar Corp., Niagara Falls, N. Y. These authors gave costs of operation and figures on energy consumption per pound of ware fired. Incidentally, corridor conversations emphasized the fact, which is sometimes obscured by current interest in electric kiln firing, that electricity has no especial advantages in ceramics, other than the obvious ones of controllability and cleanliness, and that the price of current must continue to be the determining factor.

In the symposium on color, T. S. Curtis, Industrial Research Laboratories, Huntington Park, Calif., described a new process whereby any subject that can be photographed can be reproduced faithfully in vitrefiable colors on ceramic ware. Particularly the process is suggested as a means for the low-cost decoration of tile.

The Society's enamel division presented an exceptionally large number of papers, several of which contained matter of chemical engineering interest. R. M. King, Ohio State University, described a method of electrodialysis which appears to have merit in testing durability of glass and the acid resistance of enamels and glasses. Interesting information on the mechanism of enamel adherence was presented by W. L. Housley and R. M. King, respectively of Canton, Ohio, and Ohio State University. During the ground coat firing a peculiar reaction takes place, which is possibly electrolytic, in which a dendritic structure extends from the steel into the enamel, furnishing numerous hold-fasts for the ground coat. In the past only dark ground coats seem to have developed this property. Certain white oxides have now been found that yield a dendritic formation when incorporated in enamels that may be applied directly to steel.

The great majority of the enamel papers dealt with the more esoteric details of shop practice. Two, however, concerned new information on the chemistry of enameling. H. E. Ebright, G. H. McIntyre and J. T. Erwin, all of the Ferro Enamel Corp., Cleveland, discussed the factors that control variation in furnace atmosphere, showing what effect such atmospheres have on enamel quality. The progressive combinations that occur between various of the ingredients of enamels during smelting were discussed in a program report given by A. I. Andrews and C. M. Andrews, University of Illinois, Urbana, Ill.

Considerable interest has been shown recently in the condition of sheet steel best suited to enameling. Small-radius bends at corners, it has been found, are likely to induce burning off and chipping. Whether this results from a strained condition of the metal, with consequent poor binding, or from some other condition related to surface tension is not yet known, but it has been found by H. H. Holscher, Edison General Electric Appliance Co., Chicago, Ill., that 9/64 in. represents the minimum radius to which the iron should be bent.

Several of the glass division's papers are of interest here. G. W. Morey, Geophysical Laboratory, Washington, D. C., discussed the significance of glass hardness and its testing. Progress was reported by G. E. F. Lundell, U. S. Bureau of Standards, in the development of methods for determining the chemical durability of glass. In a paper on the effect of steam on glass, O. G. Burch, Owens-Illinois Glass Co., Alton, Ill., found that it is apparently the superheated water in saturated steam which decomposes glass, for thoroughly dry steam has no apparent effect.

That the contraction of glass on cooling from fairly elevated temperatures is a function of both the peak temperature and the cooling rate has been known for some time. J. T. Littleton, Corning Glass Works, Corning, N. Y., described a photoelastic method which gives information on this effect. The results are of especial interest in connection with glass-to-metal seals.

Particularly since the question of heat transmission through glass has been forced to the fore by air-conditioning, resistance to passage of infra-red rays has become important to the glass industry. E. D. Tillyer and T. M. Gunn, American Optical Co., Southbridge, Mass., discussed the infra-red transmission properties of a range of special glasses containing most of the usual elements. The effect of sustained loading on the strength of bottle glass, plate and window glass, was covered in a preliminary manner by F. W. Preston of Butler, Pa.

New Magnesium Silicate Refractory

Among the papers presented by the refractories division was one by R. E. Birch and F. A. Harvey, Harbison-Walker Refractories Co., Pittsburgh, Pa., on the comparatively new magnesium silicate refractories. Forsterite ($2MgO.SiO_2$) is the only magnesium silicate that is stable above 1,562 deg. C. Hence such refractories are mainly of this material. The most important raw material source is said to be olivine, enriched with MgO. Forsterite refractory shows only slight subsidence after 90 min. at 1,550 deg. C. under a load of 25 lb. per square inch.

Experiments on the effect of additions of small quantities of fused alumina and B_2O_3 to plastic refractory bonding clays were described by D. G. Moore and R. K. Hursh, University of Illinois. With clay of low impurities 2 per cent B_2O_3 gave lowered thermal expansion and shrinkage, improved refractoriness and spalling resistance. Addition of 15 per cent fused alumina improved resistance to thermal shock of two out of three clays.

In a session devoted largely to the thermal aspects of refractories C. E. Weinland, Johns-Manville Research Laboratories, Manville, N. J., offered a useful graphical method for determining heat loss through furnace walls. The method obviates difficulty with temperature-conductivity functions which are not straight-line relations and permits calculation of heat transmission through compound structures. L. B. Miller, Johns-Manville Corp., Manville, N. J., analyzed the factors—economic and ceramic—controlling the use of insulation over silica refractories in open-hearth crowns. His conclusion was that insulation would prolong the life of the refractory.

A number of papers dealt with the factors affecting rates of change in refractory systems. C. C. Furnas, Yale University, New Haven, Conn., discussed three reactions—carbon deposition, reduction of iron oxides and calcination of limestone—in their relation to ceramic failure. Louis Navias, General Electric Co., Schenectady, N. Y., told of very interesting experiments showing that reactions occur in ceramic materials in the solid phase. At temperatures of 1,000 to 1,200 deg. C, Ni, Fe, Cr and Mn, in contact with MgO and BeO, all showed reaction, the reactivity increasing in that order. The oxides of these metals similarly showed reactivity, and in the same order. No reaction, or much less, occurred in hydrogen atmosphere. Other information on solid phase reactions was presented by G. R. Pole and N. W. Taylor, Pennsylvania State College, State College, Pa., who reported on reaction rates between mullite, alumina and silica with sodium and calcium carbonates. These experiments may explain the behavior of certain glass refractories when exposed to the action of dusts and vapors.

Meeting together, the structural clay products and terra cotta divisions listened to a number of papers including one by R. M. Schory, Metropolitan Paving Brick Co., Minerva, Ohio, who discussed the continuous operation of round, downdraft kilns. This author concluded that the economies of continuous operation in this case do not justify the added expense.

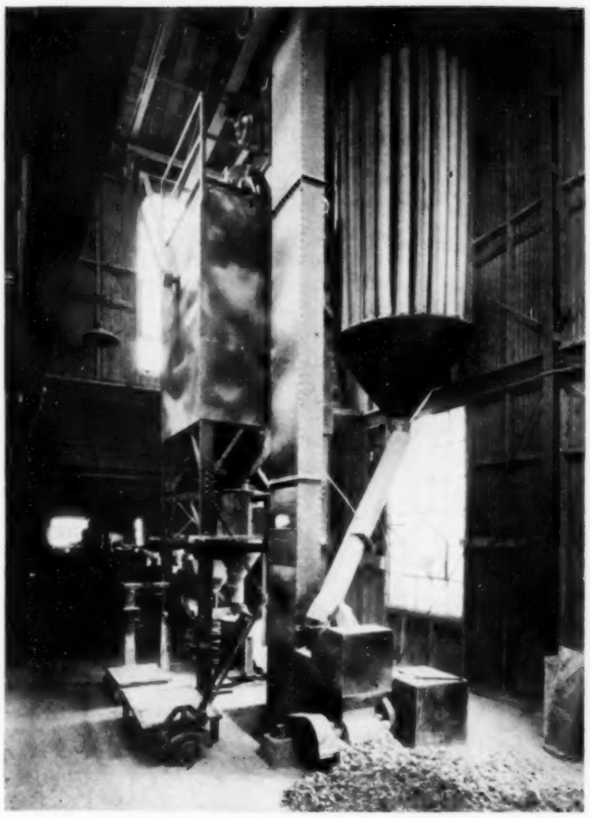
A number of papers dealt with various phases of de-airing. H. R. Straight (see *Chem. & Met.*, p. 410, Aug., 1933) discussed effect of pugging on the gas content of clay and the use of scientifically designed pugmill blades. Two papers went into the use of de-airing, one by J. O. Everhart, of Ohio State University Experiment Station, discussing the production of de-aired sewer tile; and the other, by D. F. Stevens and R. P. Stevens, Acme Brick Co., Danville, Ill., the de-airing of floor tile. Important improvements were reported. Many recent difficulties that have been encountered in de-airing have been traced to improper technique. Opinions were expressed in the discussions that no disadvantages need result from de-airing when proper methods are employed.

New Method of Refining Enameler's Clay

By RICHARD L. CAWOOD
President
Patterson Foundry & Machine Co.
East Liverpool, Ohio

CLAY is indispensable in the enamel industry where it is used as a floating agent. Its chief requirements are high colloidal properties, suspending power, white color, strength and absolute uniformity. American clays are used to some extent although the clays from the Vallendar district in Germany have come largely to be used to a greater extent in the enamel industry.

It is a well known fact that the best imported Vallendar clay contains foreign matter such as iron sulphide, wood fiber, shale, sand and a considerable amount of moisture, the latter running sometimes as high as 25 per cent. As in all ceramic bodies, impurities such as



Grinding, pulverizing and air-separating equipment for enamelers clay in plant of Ferro Enamel Corp., Cleveland

iron, silica sand and organic matter cause trouble. These impurities must be removed and the moisture content must be reduced to a very small percentage.

The German Vallendar clay is imported into the United States in large casks weighing several hundred pounds. These casks are opened and the clay chopped into chunks from 3 to 5 in. in size, which are then passed through rotary dryers, specially constructed to prevent contamination. After pulverization, ordinarily, the clay would then be considered ready for use in the enamel batch.

Recognizing the trouble caused by the presence of the foreign substances in this clay, the Ferro Enamel Corp., of Cleveland, Ohio, decided about a year ago to remove these impurities and resorted to a novel method of treatment to produce the desired results.

Obviously, the clay, after being dried, must be pulverized, inasmuch as a 200-mesh product is desired. Furthermore, before the impurities can be removed it is also necessary to pulverize the clay so that the small particles of iron sulphide, sand, organic matter, etc., can be eliminated. It was found impossible to use a ball or tube mill for this purpose inasmuch as fine grinding of the clay meant the pulverization of the impurities as well, thus making them increasingly difficult to remove. Large and powerful magnets had been used for separation of the organic matter and sand, but the screen capacity was ridiculously small for several reasons. These included the fineness of the screen, the nature of the impurities and the fact that Vallendar clay is hygroscopic, having an average relative humidity of 75 per cent. The last characteristic means that within a few hours after it is dried to this condition, the clay will regain over 5 per cent moisture and thus cause blinding of the screen. Consequently, it was necessary to develop machinery of special design and to resort to novel and heretofore untried equipment to gain the desired result. Engineers were employed to conduct experiments and to develop the necessary equipment.

In running the experiments the engineers found that, because of differences in specific gravity, the impurities could be removed by centrifugal force if a means could be devised to pulverize the clay without reducing the particle size of the impurities. Hence a specially built mill of the hammer type, with screen attached, was utilized for this purpose and a specially fitted centrifugal air separator was evolved for the removal of the particles from the pulverized clay.

After many laboratory experiments had been run with equipment of small size a plant was designed and installed in a new building provided for housing it. Not only has the purpose for which the plant was installed been accomplished in so far as the fine grinding of the clay and the removal of impurities is concerned, but an operation which would ordinarily be very dusty is now conducted in such a manner as to eliminate all dust hazard. Additionally, production costs have been materially reduced.

As the clay is delivered from the dryers it is usually in chunks from 2 to 4 in. in size and these are fed directly into a fine-toothed roll crusher driven by a 5-hp. direct-connected motor, the cutting roll operating at 865 r.p.m. and the feed roll at 90 r.p.m. This delivers the crushed clay at $\frac{1}{4}$ in. mesh and finer. An inclosed elevator carries the crushed material to the hammer mill which pulverizes the clay, which is softer than the impurities. This mill operates at 3,600 r.p.m. and is powered with a 15-hp. direct-connected motor.

Most of the material delivered by the hammer mill is 200 mesh but what oversize there is is removed by the air separator along with the impurities, consisting of the iron sulphide, silica sand and organic matter. This separator is 5 ft. in diameter and operates at 275 r.p.m., requiring 5 hp.

The hammer mill is not operated in closed circuit with the air separator for to do so would necessitate returning the impurities along with the oversize. The impurities having been removed, the finished product is bagged as it is discharged. A dust collecting system collects the dust which is generated at two points, first, at the toothed roll crusher and, second, at the point where the bagging takes place. The fines collected by this dust system are returned for bagging. The tailings containing the oversize as well as the impurities are then rerun with great care and much of the clay that would otherwise be wasted is recovered. The capacity of the outfit is approximately 2,000 lb. per hour.

Under the old method of processing, the residue averaged about 0.5 per cent while the iron content was 0.0006 per cent, or an iron equivalent of about 3 grams per 1,000 lb. of clay. This was sufficient to cause contamination when it occurred in small granular pieces. After the installation of the new processing unit the residue was reduced to 0.0017 per cent and the iron content to 0.00006 per cent, thus reducing the residue approximately 99.66 per cent and the iron content approximately 90 per cent. The finished product passes 99.9 per cent through 200 mesh while the cost of processing has been reduced 60 per cent.

Chemical Engineer's BOOKSHELF

German Chemical Engineering

Chemische Ingenieur—Technik, Vol. I. Edited by *Ernst Berl.* Verlag von Julius Springer, Berlin. 874 pages. Introductory price for series of three volumes 248 Rm. Volumes not sold separately. Later subscription price will be 310 Rm.

Reviewed by *S. D. Kirkpatrick*

KNOWN personally as yet to but comparatively few American chemical engineers, yet almost universally recognized and respected for his outstanding work, Prof. Ernst Berl of Carnegie Institute of Technology now adds another significant contribution to the chemical engineering literature of the world. His long association and collaboration with another great leader gave us the famous Berl-Lunge texts that are known and used wherever there is chemical industry. It was most logical, therefore, that he should have been selected to edit and contribute so largely to this new German reference book of chemical engineering.

So far only the first of the three volumes has reached this country, but it is evident from the detailed announcement of content and scope that the entire series will present a most comprehensive coverage of technology by leading German authorities in the different fields. Thus in the present volume Dr. Berl has had the collaboration of the following: Mathematical Fundamentals, by Prof. A. Walther of Darmstadt; Thermodynamics and Catalysis, by Prof. H. Mark of Vienna; Phase Rules, by Prof. E. Janecke of Heidelberg; Fuels and Combustion, by Prof. Berl and Dr. K. Winnacker of Frankfurt-a-Main Hoechst; Electrochemical and Electrical Applications, by Dr. W. Speidel, Halle-a-S.; Materials of Construction, by Prof. August Thum of Darmstadt and Dr. Helmut Holdt of Darmstadt; and Process Measurements and Control, by Dr. A. Ernst and Dr. C. Hilburg of Ludwigshafen-a-Rh.

In planning and developing this volume, Dr. Berl has been guided by a most interesting philosophy. As he writes in his foreword, "Chemical industry is today more and more approaching a planned, industrial utilization of scientific research — thus making it difficult to define the borderline between scientific development and practical application. In this presentation the reader will find the theoretical and practical sides of all questions given equal treatment. Departing from the practice of older textbooks, the authors attempt to give the reader the 'why' as well as the 'how' of chemical engineering." How well the book succeeds in that commendable direction depends, of course, upon the authors' ability to satisfy the readers' needs. Quoting again from the editorial foreword: "A critical reviewer may find certain lack of uniformity in the different sections. It is a matter of opinion as to how long or how short to make the theoretical discussion or how much space to give to the practical. The best way to meet such objections is to cite the scientific and technical reputations of the men responsible for the various sections, all of whom belong with the leaders in their individual fields."

Although it has been in preparation for a long time, "Chemische Ingenieur-Technik" appears in this country almost exactly a year after the publication of the first comprehensive American handbook of chemical engineering. Prepared quite independently of each other, it is somewhat surprising to note how very similar they are in scope and treatment — although certainly not in appearance. Perry's "Chemical Engineer's Handbook," printed in standard American handbook style on India paper with the usual flexible binding, contains slightly more than 2,600 pages in its single volume. The German work follows somewhat more the textbook style with heavier coated paper and stiff board, cloth-covered binding. Accordingly three volumes are required for its total of approximately 2,300 pages. Page size in Perry's is perhaps a third less than in Berl's, but because of the more compact presentation, the former actually contains slightly more textual matter. Those whose slide rules readily convert reichmarks to our depreciated dollars will note another substantial difference.

Carrying the comparison on to the context, it is of passing interest to note that while almost exactly the same space has been given to the sections on electrochemistry and fuels and combustion, for example, the American book presents three times as many data on mathematical principles, tables, etc., as does the German. However, the latter exactly reverses this proportion in the case of the section on instruments and measurements, and in an excellent chapter on materials of construction, it practically doubles in pages the coverage in Perry's. Obviously such comparisons of quantity rather than quality are of questionable value but they do emphasize the similarity in scope and treatment in these two handbooks.

Professor Berl, his distinguished collaborators, and the efficient and enterprising publisher, Verlag von Julius Springer, are all to be congratulated on this truly excellent production, which adds significantly to the world's chemical engineering literature.

Gas Monograph

Gas-, Coke-, and Byproduct-Making Properties of American Coals and Their Determination. U. S. Bureau of Mines' Monograph 5. By *A. C. Fieldner* and *J. D. Davis.* Printed by American Gas Association, New York. 164 pages. Price, $1.50 (paper), $3 (cloth).

Reviewed by *B. H. Strom*

MORE than seven years ago an investigation was started under a cooperative agreement between U. S. Bureau of Mines and American Gas Association, the result of which is summarized in this report. The method developed has been applied to 30 different coals, covering all ranges of volatile content, for temperatures between 500 and 1,100 deg. C. Complete data, in tabulated form, are given for all samples, illustrating the trends in yields and properties of carbonization products in relation to temperature of carbonization. The heat treatment of any type of coal may thus be modified to give the best returns. Furthermore, the method may also be used to determine the effect of washing coal on the quality of the coke and on byproduct yields, and of blending and addition of inerts to the coal.

Fabrics in Industry

Handbook of Industrial Fabrics. By *George B. Haven.* Published by Wellington Sears Co., New York. 538 pages. Price, $2.

WITH the growing importance of accurate specifications for engineering materials—a trend which during the last two decades has also been extended to textiles—it is of importance to all connected with this field to familiarize themselves with current specifications as well as with the methods of establishing the physical properties of fabrics. This handbook is written for engineers, salesmen, executives, and students of textiles, to clarify and extend their general knowledge.

Welding and Cutting

OXY-ACETYLENE COMMITTEE PUBLICATIONS. Compiled and presented in four sections by the Oxy-Acetylene Committee, International Acetylene Assn., 30 East 42nd St., New York City.

SECTION I, Oxy-Acetylene Cutting. A discussion of the fundamentals of the process, equipment, and operating technique.

Section II, Oxy-Acetylene Welding and Its Applications. Recommended procedures for a variety of metals, together with control test methods suggested for high quality work.

Section III, Miscellaneous Uses of the Oxy-Acetylene Flame, including glass working, metal heat-treating, carbon burning, wood charring, metal coating, paint removal, etc.

Section IV, Welding Codes and Specifications. A resume of standard requirements for the production of acceptable welding on pressure equipment, fired and unfired pressure vessels as defined by A.S.M.E., A.P.I., and others and for a variety of standard engineering work.

Hard-Working Electrons

ELECTRON TUBES IN INDUSTRY. By *Keith Henney*. Published by McGraw-Hill Book Co., New York. 490 pages. Price, $5.

Reviewed by *T. R. Olive*

FOR AN ENGINEER who makes small pretense to any electrical knowledge, yet who enjoys reading about the latest wonders of electricity, provided they occasion him no undue mental strain, this book has proved a most fascinating relaxation. For other engineers with problems that can be answered by the relatively new science of electronics, it may well prove indispensable. Light-sensitive and thermionic tubes have many applications in the field of communications, where they are now well known and thoroughly treated in the literature. It is only within the past five years, however, that the non-communication uses of such tubes have become impressive, and within the covers of this book a large, disordered literature on these applications has finally been crystallized.

Most engineers outside the electronic industries know of, and perhaps understand, a few of the uses for these efficient, untiring, instantly-acting workers, the electron tubes, but it was a revelation to one such engineer to discover the enormous range of applications that is already practicable. Having covered the bases of electronic-tube circuits and the several fundamental tube types, Mr. Henney launches the reader into a variety of applications ranging from the amplification of currents too small to measure to the counting of alpha-particles at speeds too great for any mechanical counting system. He covers in great profusion measuring instruments that derive their accuracy from electron tubes. He covers numerous control methods, many applicable in process plants. Accurate timing devices, telemetering instruments, rectifiers and inverters are some of the subjects treated. Light-sensitive devices, including the latest types, are thoroughly described and explained with many of their applications.

If the editors of *Electronics*, a magazine of which Mr. Henney is associate editor, are correct in their prognostications, there is very little that electronic science of the future will not be able to do. What it can do at present is almost incredible. The engineer who aspires to make these ultimate particles jump through his loop had best hie himself to the nearest copy of this volume. Incidentally, he will enjoy the experience.

WATER SUPPLY AND TREATMENT. By *Charles P. Hoover*. Published and distributed by National Lime Association. 143 pages.

AMONG the subjects covered in this treatise are coagulation and sedimentation, filtration, sterilization, corrosion prevention, water softening, chemistry of soda-ash process, zeolite process, treatment of boiler feed water, recarbonation of lime-softened water, and methods of analysis. The text should be useful to plant operators, engineers, and students interested in water treatment.

GOVERNMENT PUBLICATIONS

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.

Mineral Resources and Possible Industrial Development in the Region Surrounding Boulder Dam. Bureau of Reclamation unnumbered document.

Production Statistics From 1933 Census of Manufactures—printed pamphlet on: The Sugar Industries and Corn Sirup, Corn Sugar, Corn Oil, and Starch; 5 cents.

Statistical Abstract of the United States 1934. Bureau of Foreign and Domestic Commerce; $1.50 (Cloth). Summary of authoritative statistics showing the trends in trade and industry, as well as social progress. A convenient reference work.

Foreign Commerce and Navigation of the United States, The Calendar Year 1933. Bureau of Foreign and Domestic Commerce; 576 pages, $1.75 (Buckram). Gives import and export statistics.

Base Exchange and Related Properties of the Colloids of Soils From the Erosion Experiment Stations, by C. S. Slater and H. G. Byers. Department of Agriculture Technical Bulletin 461; 5 cents.

A Study of Some Seismometers, by G. A. Irland. Bureau of Mines Technical Paper 556; 10 cents.

Manufacture, Composition, and Utilization of Dairy Byproducts for Feed, by Mayne R. Coe. Department of Agriculture Circular 329; 5 cents.

Tennessee Valley Authority, Annual Report for the Fiscal Year Ended June 30, 1934. With Technical Appendixes. House Document 82, 74th Congress, 1st Session; 10 cents.

Binders Board for Bookbinding and Other Purposes. Bureau of Standards Commercial Standard CS50-34; 5 cents.

Index of Federal Specifications. Federal Standard Stock Catalog, Section IV, Part 1, Revised to September 1, 1934; 10 cents.

Federal Specifications. New or revised specifications of the Federal Specifications Board on: Blue-lead, basic-sulphate, dry and paste-in-oil, TT-B-486; Grease, lubricating, crank-pin, and rod-cup, VV-G-651; Oil, cutting, mineral-lard, VV-O-251; oil, cutting, soluble, Amendment 1, VV-O-261. The above specifications are available from the Bureau of Supplies and Accounts, Navy Department.

Lime. Detailed statistical appendix to Minerals Yearbook 1934; 5 cents. Lime Industry in 1934, preliminary statistics; Bureau of Mines M.M.S. 347; mimeographed.

Petroleum, Petroleum Products, and Natural Gasoline. December, 1934, Including Preliminary Totals for 1934. Bureau of Mines Monthly Petroleum Statement P.128; mimeographed.

Phosphate Rock Industry in 1934—Advance Summary. Bureau of Mines M.M.S. 348; mimeographed.

Motion Pictures of the U. S. Department of Agriculture, 1934. Department of Agriculture Miscellaneous Publication 208; 5 cents.

Educational Directory 1935, Part III, Colleges and Universities, including all institutions of higher education. Office of Education pamphlet; 5 cents.

Selected Trade Associations of the United States, by C. Judkins and L. Marceron. Bureau of Foreign and Domestic Commerce unnumbered document; 10 cents, mimeographed. Copies are obtainable only from the Bureau of Foreign and Domestic Commerce.

Tungsten, by William O. Vanderburg. Bureau of Mines Information Circular 6821; mimeographed.

Asbestos—General Information, by Oliver Bowles. Bureau of Mines Information Circular 6817; mimeographed.

Assay of Black Sands, by Paul Hopkins. Bureau of Mines Report of Investigations 3265; mimeographed.

Concentration of the Potash Ores of Carlsbad, New Mexico, by Ore Dressing Methods, by Will H. Coghill and others. Bureau of Mines Report of Investigations 3271; mimeographed.

Tabulated Analyses of Texas Crude Oils, by Gustav Wade. Bureau of Mines Report of Investigations 3252; mimeographed.

Dewatering Clay Suspensions by Spray Evaporation, by Hewitt Wilson and others. Bureau of Mines Report of Investigations 3248; mimeographed.

Thermodynamic Data on Some Metallurgically Important Compounds of Lead and the Antimony-Group Metals and Their Applications, by Charles G. Maier. Bureau of Mines Report of Investigations 3262; mimeographed.

Studies in Zinc Metallurgy, by H. A. Doerner and others. Bureau of Mines Report of Investigations 3256; mimeographed.

Smelting in the Lead Blast Furnace; Handling Zinciferous Charges, by G. O. Oldbright and Virgil Miller. A series of Bureau of Mines Reports of Investigations as follows: XI.—Preparation of the Charge by Sintering, R.I. 3243; XII.—The Gases Within the Blast Furnace at Top and Tuyeres, R.I. 3244; XIII.—Accretions at Various Elevations Within Blast Furnace, and Factors Governing Manner and Rate of Descent of Stock Column, R.I. 3245; XIV.—Methods of Charging the Blast Furnace, Their Effect on Furnace Operation, R.I. 3246; XV.—Slags From the Trail Blast Furnaces, R.I. 3264.

Your Plant NOTEBOOK

THERMAL VALUE NOMOGRAPH FOR BITUMINOUS COAL

By D. S. Davis
Dale S. Davis' Associates, Watertown, Mass.

THE accompanying nomograph, based on Mahler's data ("Mechanical Laboratory Methods," Van Nostrand, p. 176, 1924) enables rapid estimate to be made of the thermal value of bituminous coal when the proximate analysis is known.

The use of the chart is illustrated as follows: Given the analysis, on the "as received" basis:

	Per Cent
Volatile combustible matter...	33
Fixed carbon	57
Ash	7
Moisture	3

find the heating value in (1) B.t.u. per pound of combustible; (2) B.t.u. per pound of coal as received; and (3) B.t.u. per pound of bone-dry coal.

1. Note that the sum of the ash and moisture percentages is 10. Connect 57 on the fixed-carbon scale with 10 on the horizontal ash-plus-moisture scale and produce the line to the A-axis. From this intersection erect a perpendicular to meet the curve and then proceed horizontally to the scale at the extreme left, reading the heating value as 15,100 B.t.u. per pound of combustible.

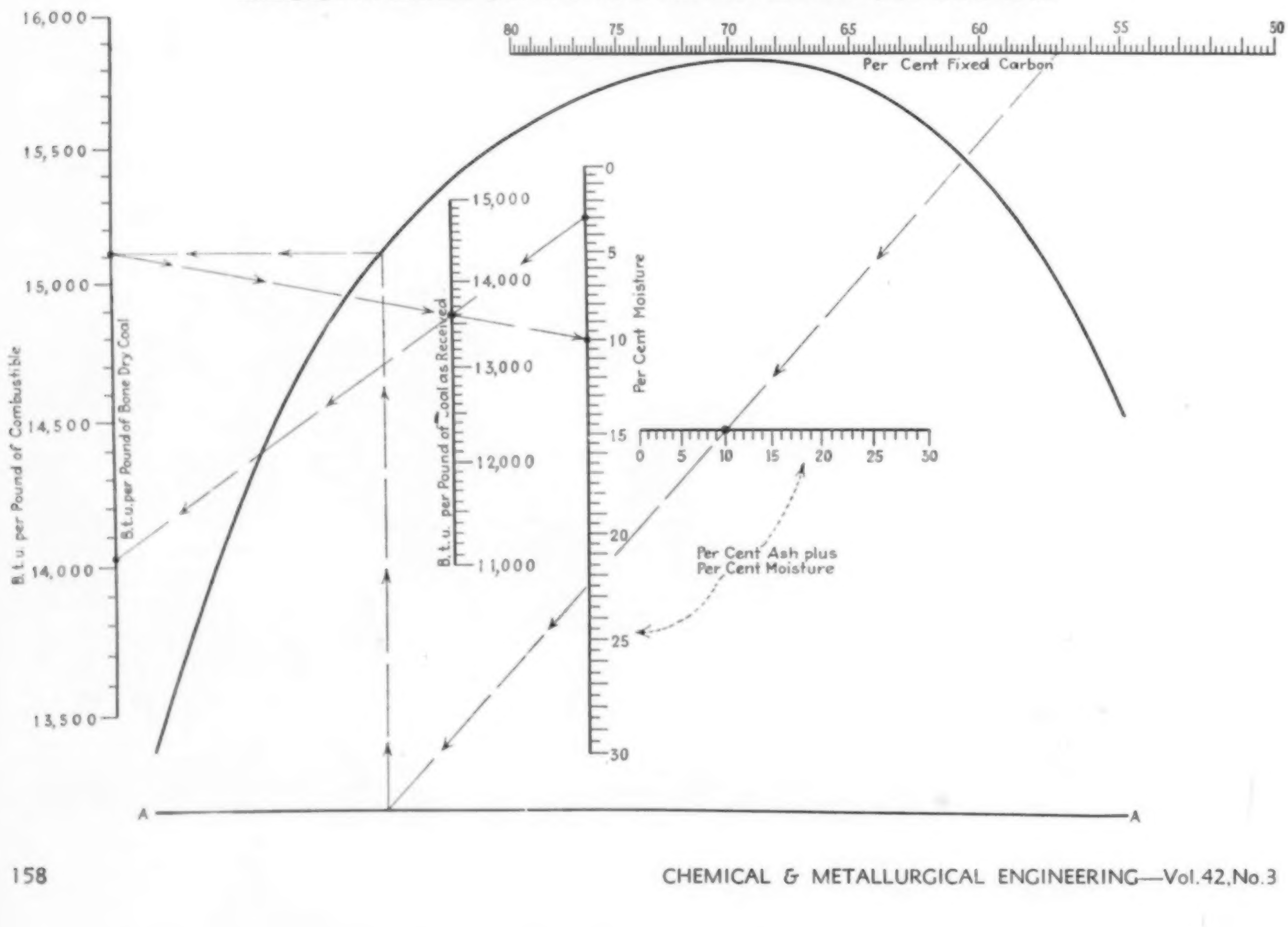
2. A line from this point to 10 on the vertical ash-plus-moisture scale will cut the "B.t.u. per Pound of Coal as Received" scale at 13,600.

3. Connect this latter intersection with 3 on the vertical moisture scale and produce the line to meet the scale at the left in the value 14,000, which is the number of B.t.u. per pound of bone-dry coal.

This method of calculation gives results good to within 2 per cent for bituminous and semi-bituminous coals which run above 55 per cent in fixed carbon, and to within about 3.5 per cent when the fixed carbon percentages are between 50 and 55.

For most convenient use the chart can be photostated and the photostat mounted on a light frame bearing

Nomograph for determining B.t.u. values of bituminous coals from proximate analyses



raised edges at the bottom and left. The raised edges, together with a draughtsman's triangle, facilitate drawing the perpendiculars and horizontals.

Calculation of Mixtures of Oleum and H_2SO_4

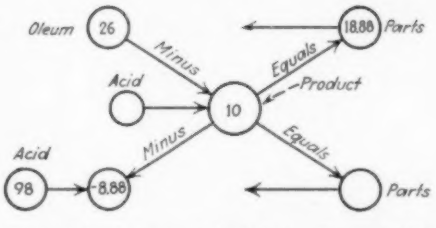
By J. W. Fickenscher
Cincinnati, Ohio

PEARSON'S SQUARE, a simple device for calculating the proportions of components required for a mixture, can easily be applied to the calculation of oleum and sulphuric acid to produce intermediate mixtures of any desired strength. The method described by George S. Santmyers in the December, 1933, issue of *Chem. & Met.*, can be used for this purpose, provided that tables are at hand so that the acid and oleum can be expressed on a common basis, either in terms of per cent total SO_3 or per cent total H_2SO_4. However, sulphuric acid is generally expressed in per cent H_2SO_4, while oleum is expressed in per cent free SO_3. The author's method consists in the use of Pearson's Square after making a simple transformation to a common basis which requires no tables and very little calculation.

When both components are expressed in the same units the method described by Mr. Santmyers is employed without variation. Ordinarily, however, it will be necessary to convert the acid into terms comparable with the oleum, which is done as follows: The percentage of water in the acid is multiplied by the ratio of the molecular weights of SO_3 to H_2O (=4.44) and the negative of the quantity resulting is substituted in the square for the percentage of the acid. In other words, the acid is entered as the *negative* per cent SO_3, that is, as the per cent SO_3 by which it fails to reach 100 per cent H_2SO_4. Oleum is entered on the square as per cent free SO_3.

However, it is not necessary to remember this rather involved explanation in making use of the method. It is only necessary to remember that the percentage of water in the acid is to be multiplied by —4.44, and to enter the various quantities properly on the square.

The accompanying illustration shows a convenient way of entering the data, together with the solution of a typical problem. Let it be required to mix 26 per cent oleum with 98 per cent H_2SO_4 to produce 10 per cent oleum. Then: (100—98) (—4.44) = —8.88, which is the negative percentage of free SO_3 in the acid. Entering this on the



Pearson's Square adapted to the solution of oleum-sulphuric acid mixtures

square, together with the per cent of the oleum used in the mix and that resulting from the mixture, we find by subtraction, as indicated by the arrows, that: 26—10=16 parts of 98 per cent H_2SO_4 is required and 10—(—8.88) =18.88 parts of 26 per cent oleum is required to produce 34.88 parts of 10 per cent oleum.

Thus it is evident, once the acid has been converted to a basis comparable to the oleum, that the method of calculation is exactly similar to the usual means of employing Pearson's Square. The percentage representing the more concentrated constituent is entered in the upper left, and the percentage for the less concentrated constituent in the lower left position, while the required percentage is entered at the intersection of the diagonals. Subtractions are then made along the diagonals according to the arrows, and the results are read at the right hand corners, as applying to the constituents on the same horizontal level. The method is equally applicable to the calculation of mixtures containing 100 per cent sulphuric acid or weaker acid.

Automatic Weigher for Bulk Materials

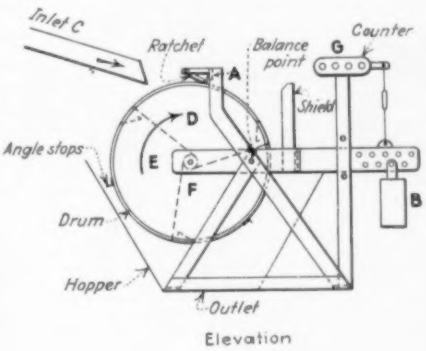
By O. O. Bishop
Superintendent
Worcester Salt Co.
Silver Springs, N. Y.

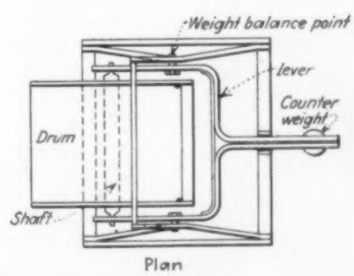
A SIMPLE weighing machine, similar to the accompanying sketch, has been in operation at our Silver Springs plant for a considerable time, giving a good account of itself in checking the production of finished salt on its way to storage. The weigher is constructed principally of iron, with the drum-shaped portion, which does the actual weighing, built of Monel metal.

The accuracy, of course, is not equal to that of many of the continuous weighers on the market, but is sufficiently good for the use to which it is put, having a precision within about 2 per cent under our conditions of operation.

The drum, which rotates in the direction of the arrow, contains partitions which divide it into three compartments. On the periphery of the drum, situated about midway between the partitions, are angle stops which serve to hold the drum in position while any one compartment is being filled. The drum is supported on a pivoted and counterbalanced lever so that until a certain predetermined weight of salt has been reached in one of the compartments, the drum is pushed up against a retarding bar, *A*. The angle stop bears against *A* and prevents forward rotation, while a ratchet shown in the sketch contacts the angle stop at the rear, preventing kickback. The counterweight, *B*, may be attached to the lever at any one of several points so that the weight required to release the drum may be varied as desired.

Operation of the device is as follows: Material flows from the inlet, *C*, into compartment, *D*, until the quantity re-





Plan and elevation of simple, automatic, continuous weigher for bulk materials

quired to balance the weight, *B*, has entered. Immediately the drum moves downward so that the angle stop is released at *A*. Having done so, the drum quickly rotates clockwise, discharging its contents into the hopper. Rotation continues until the angle stop on compartment *E* strikes *A* which arrests the rotation while *E* is being filled. This action continues as long as the material flows, each dumping being recorded on a counter, *G*, so that at stated intervals the weight that has passed may be calculated by multiplying the weight per dump by the number of dumps.

News of EQUIPMENT

Carbon Filter Shapes

A new filter material known as "Fabricated Filter Carbon" has been announced by the National Carbon Co., Carbon Sales Division, Cleveland, Ohio. This material is available in various forms including plates, pipe and blind-

Variety of filter carbon parts

end tubes. Special shapes can be produced to order. The new filtering medium is said to be unaffected by all acids, alkalis and corrosive materials except hot concentrated solutions of highly oxidizing character. It is said to be light in weight, mechanically strong, highly resistant to thermal shock, readily machined and easily cleaned. It is produced in several grades, each possessing a different degree of porosity.

Carbon Monoxide Alarm

A carbon monoxide alarm which gives a prompt warning by ringing an electric gong when the concentration of CO in air reaches the danger point has been put on the market by the Mine Safety Appliances Co., Pittsburgh, Pa. It is pointed out by the manufacturers that a concentration of 0.02 per cent CO will produce headache in a few hours exposure. Concentration of 0.06 per cent will produce unconsciousness in two hours while 0.10 per cent may prove fatal in approximately 4 hours. Consequently, the new alarm has been designed to give warning when the concentration reaches 0.02 per cent. The apparatus consists of a small motor-driven fan which pulls a continuous sample of air through a screened funnel. The air passes over heated coils, then enters a divided, insulated cell containing active and inactive Hopcalite. Any carbon monoxide present is converted into carbon dioxide with the liberation of heat in proportion to the amount of gas in the air. This heat is measured by thermocouples and is indicated on a dial in terms of CO concentration. The indicator is designed to make positive contact at 0.02 per cent concentration and this serves to operate the alarm.

Alternating-Current Separator

Type AM is the designation of a new separator for concentrating highly magnetic substances, recently announced by the Magnetic Manufacturing Co., Milwaukee, Wis. An important characteristic of the new machine lies in the fact that it employs alternating current of any standard voltage instead of the direct current that has heretofore been used in magnetic equipment. Because of the high pulsation of the field the new separator is said to be especially effective in cleaning finely powdered materials. Separation is accomplished by feeding the mixed materials to a suspended type magnet located within a belt conveyor. While in the magnetic field the magnetic material is lifted and carried in suspension, but is automatically discharged as soon as the belt leaves the field.

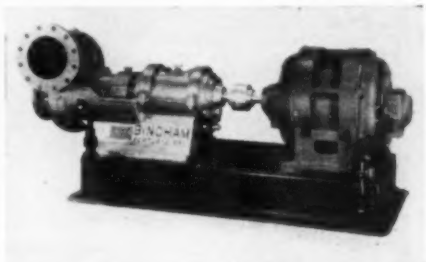
New a.-c. magnetic separator for fine materials

This same concern has recently redesigned its line of "Super" Type B spout-type separators and now announces that the improved machine is the only one that has so far been given unrestricted approval by the Mutual Fire Prevention Bureau, of Chicago.

Hot-Acid Pumps

Bingham Pump Co., East 7th at Main St., Portland, Ore., has announced the development of a new line of hot-acid pumps, designed for paper mill work, but also adaptable to many other purposes in process industries. These pumps are of the centrifugal type and are provided with a deep, water-cooled stuffing box and a water-cooled bearing cylinder, this design permitting the pump to handle acids at exceedingly high temperatures with a minimum of maintenance, according to the manufacturers. The pumps are mounted upon four adjustable springs, held in position by a foundation base, a type of construction which is employed to prevent expansion changes in the line from distorting the pump or forcing pump and motor out of alignment.

This company has also developed a line of SO_2 compressors made of alloy steels resistant to this gas and to sulphurous acid. The compressor is designed to handle both hot and cold gas at



Pump with water-cooled parts for handling hot acid

pressures up to 75 lb., in smaller sizes, and to 50 lb. in larger sizes. Construction is of the wet rotary type in which there is no contact between the rotating part and other parts of the compressor.

Non-Hunting Controller

C. J. Tagliabue Mfg. Co., Park and Nostrand Aves., Brooklyn, N. Y., has recently announced that its photoelectrically balanced potentiometer pyrometer is available in a control model so designed as to give non-hunting, nondrifting control action. The potentiometer recorder was described in our June, 1934, issue. The method of attaining balance will, therefore, not be repeated here. The new controller is designed to take care of severe cases of apparatus lag which make control without hunt-

ing generally difficult. It is said to result in nearly perfect elimination of hunting. Results are obtained by adding to the recorder a control-setting slide-wire, a cam-operated thermocouple switch and cam-operated control switch.

While the thermocouple is connected to the recording slide-wire, the contact carriage follows the true temperature and records it. This occurs about 95 per cent of the time and during its occurrence, if the temperature increases or decreases, the control motor decreases or increases the heat supply in proportion to the change. At intervals, however, the potential of the control setting is substituted for that of the thermocouple and the contact carriage is brought to the correct or normal point, with the control motor disconnected. Then the thermocouple and control motor are reconnected and the contact carriage returns to the true temperature so that the control motor now corrects the heat supply in proportion to the measured departure from normal.

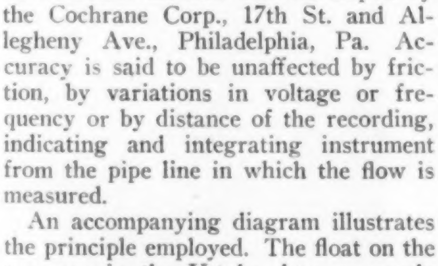
Null-Point Flowmeter

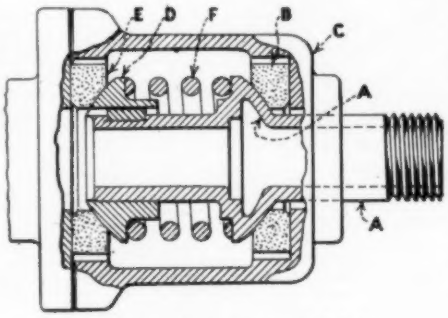
High accuracy, ruggedness and flexibility are said to be attained in a new electric flowmeter, using the null or zero-balance method and developed by the Cochrane Corp., 17th St. and Allegheny Ave., Philadelphia, Pa. Accuracy is said to be unaffected by friction, by variations in voltage or frequency or by distance of the recording, indicating and integrating instrument from the pipe line in which the flow is measured.

An accompanying diagram illustrates the principle employed. The float on the mercury in the U-tube does no work, but by its position affects the balance of an a.-c. bridge circuit, controlling electrically a relay which directs ample power from an independent source for readjustment of the circuit to restore balance and perform all work of recording, indicating and integrating. The application of power required to shift the recorder armature is controlled by the boom of a sensitive galvanometer. The value recorded is that at which balance is attained, regardless of the direction from which balance is approached. The circuit and galvanometer are so proportioned that a displacement of the transmitter armature of less than 0.001 in. is registered.

With this system the receiver and transmitter may be located several miles apart. Not more than 25 watts of electricity is consumed. Integration of the flow is performed at least once a minute and the total recorded on a counter. The square-root relation is compensated and the chart and indicator scales, consequently, have uniform divisions.

Wiring diagram of electric flowmeter





Oilless rotary pressure joint

Rotary Pressure Joint

For conveying gases, vapors and liquids of all kinds, under pressure, into rotating equipment, the Johnson Corp., Three Rivers, Mich., has devised an oilless, rotary, pressure joint, consisting of only seven major parts. The joint has no metal-to-metal bearings, requires no adjustment, has no packing and is said to be suitable for pressures to 200 lb. at speeds to 600 r.p.m. The construction, as shown in the sketch, involves a rotating member, *A*, which seats pressure-tight against a composition seal ring, *B*. The latter, in turn, seats against the body, *C*. A convex flange, *D*, keyed to the rotating member, seats against a second seal ring, *E*, and the latter in turn seats against the body. A spring, *F*, serves to keep both flanges seated when there is no pressure on the joint. When the joint is under pressure, pressure builds up within the body and serves to maintain pressure-tight joints between the flanges, the seats and the body. Because of the spherical surfaces of the flanges and the play of the seats within the body, a considerable degree of both angular and lateral flexibility is possible with this joint. Sizes available range from ½ to 3 in.

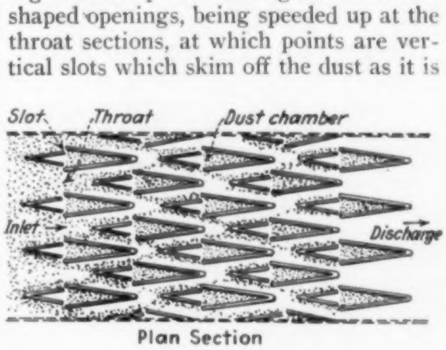
Improved Power Pump

An 18-in. stroke, totally-inclosed, horizontal, duplex power pump for a wide range of services has recently been announced by the Worthington Pump & Machinery Corp., Harrison, N. J. The power end is simple, strong and ruggedly built for hard continuous duty with a minimum of attention. The frames are cast en bloc and all moving parts are totally inclosed. All bearings are flood-lubricated. The power end may be used either with packed piston or outside-end-packed plunger types of liquid ends for either hot or cold liquids.

Venturi Dust Trap

The accompanying sketch shows a plan cross-section of a new dust-separating device known as the Thermix venturi dust trap, that has been developed by Prat-Daniel Corp., Empire State Bldg., New York City. This collector is stated not to meet as high efficiency requirements as this concern's multiple-cyclone, fan and filter-type collectors but is intended for industrial and power plant dusts and ashes that are relatively coarser than 200-300 mesh. For such dusts the compactness, low draft loss and low investment cost of the new collector make it desirable, according to the manufacturers.

The apparatus consists of a series of venturi-shaped passages extending from the bottom of a duct to within a short distance of the top. The gas or air bearing the dust passes through the venturi-shaped openings, being speeded up at the throat sections, at which points are vertical slots which skim off the dust as it is forced toward the walls by momentum. The dust, after entering the slots, falls by gravity into a hopper. Since it is desirable, in avoiding eddy currents, to have a slight stream of gas flowing into the slots, a gas bypass connects to the top of each dust chamber. The velocity of this gas, however, is said to be low enough to prevent carrying dust into the bypass. The slot openings are adjustable, it should be noted, to provide for regulation to existing requirements.



Cross-section of venturi-type dust collector

Equipment Briefs

Chicago Eye Shield Co., 2300 Warren Blvd., Chicago, Ill., has recently improved the design of its No. 81 respirator for maximum wearing comfort. New features include a correctly shaped face cushion of non-toxic rubber, a replaceable knitted cloth facelet and a new type diaphragm relief valve which is said to insure immediate release of exhaled air.

For producing a gas containing 75 per

cent hydrogen and 25 per cent nitrogen, useful in most industrial applications requiring hydrogen, the Ajax Electric Co., Frankford Ave. and Allen St., Philadelphia, Pa., has announced a new electric ammonia dissociator. Anhydrous ammonia is vaporized and then dissociated by passing the gas through a bed of catalyst material which is electrically heated. With anhydrous ammonia at 15.5 cents per lb. and electricity at 1 cent per kw.-hr., the total cost per 1,000 cu. ft. of gas is $3.71.

A close-coupled centrifugal pump, built in capacities from 100 to 600 g.p.m. against heads up to 189 ft., has recently been added to the line of pumps made by the Chicago Pump Co., Chicago, Ill. This is a single-stage, end-suction pump with the impeller and motor on a single shaft. The impeller is inclosed and is cast of bronze in one piece. The pump is supplied either with or without a water seal.

Allis-Chalmers Mfg. Co., Milwaukee, Wis., has developed what is known as the new Seal-Clad induction motor. This motor is of the open type with its most vulnerable part, the stator windings, protected by a molded Bakelite shield which is sealed over the coil ends. Such motors are built in ratings up to 25 hp.

A new alternating-current welder, known as the Lincoln "Shield Arc AC," has been announced by the Lincoln Electric Co., Cleveland, Ohio. This welder is said to be of revolutionary design, employing a motor generator to convert 2- or 3-phase alternating current of standard voltage and frequency into alternating current of a lower voltage and higher frequency most suitable for arc welding. This innovation is said to improve arc and weld characteristics and to give better power characteristics to the line. This company has also developed the new "Toolweld" arc welding electrode for hard-facing and building up cutting edges, giving a deposit which is said to be equivalent to high-speed tool steel.

The Foxboro Co., Foxboro, Mass., has combined its membrane-type relative-humidity measuring element with its Rotax type electrical control contacts, producing a new indicating-type relative-humidity controller said to be of high accuracy. The controller is used to maintain humidity through operation of solenoid or motor valves on water, air or steam lines. Its range is from 0 to 100 per cent relative humidity at temperatures between 10 and 120 deg. F.

For use in confined spaces, where the temperature or humidity is high, the American Optical Co., Southbridge, Mass., has developed the new "Duralite-50 Hot Workers' Goggle." The new goggle is said practically to double the area allowed for ventilation back of the lens and so to eliminate fogging and steaming.

For normalizing welded joints in pressure piping systems, and especially useful for field operation, is a new electric weld-stress reliever for pipes ranging from 6 to 24 in. diam. It is offered by Detroit Electric Furnace Co., 825 West Elizabeth St., Detroit, Mich. Induction heat is applied to the areas to be relieved, the power being supplied by a special transformer which is mounted on a hand truck.

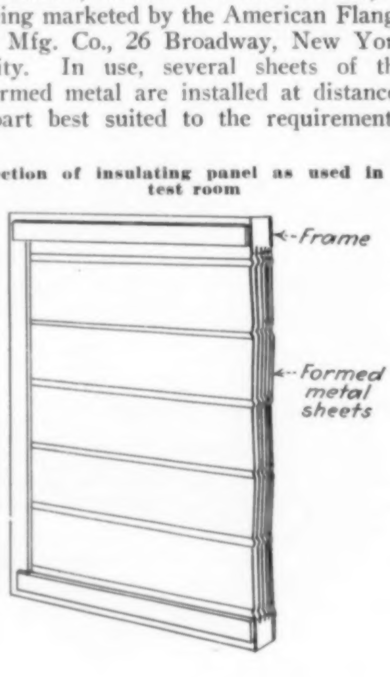
For use either indoors or out, the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has announced a new splash-proof, drip-proof motor, especially designed for such applications. To secure high resistance to corrosion, the motor frame and end brackets are solid castings, and even the conduit box is made of cast iron so that there is no exposed sheet steel. This motor is available in both squirrel-cage and wound-rotor types.

Type W-23 is the designation for a new heavily-coated arc-welding electrode for high-speed work in the flat position, recently announced by the General Electric Co., Schenectady, N. Y. These electrodes are intended for both manual and automatic welding, and for either alternating- or direct-current use. Typical stress-relieved welds show a tensile strength of about 65,000 lb. and an elongation of 2 in. of over 31 per cent.

Black Iron Insulation

Perhaps the most surprising development shown at the recent Power Show in New York was a new form of heat insulation consisting of parallel plates of black sheet iron, creased into angularly arranged surfaces, with small ribs at the junctures of these surfaces. This insulation, known as Ferro Therm, is being marketed by the American Flange & Mfg. Co., 26 Broadway, New York City. In use, several sheets of the formed metal are installed at distances apart best suited to the requirements,

Section of insulating panel as used in a test room



with spacers at intervals to prevent a general circulation of air. The resulting insulating effect, it is stated, is better than that of cork, while the material is said to be less costly than any other standard insulating material.

Ferro Therm depends for its efficiency on the high reflectivity of black iron for energy frequencies in the radiant heat range. This efficiency was convincingly demonstrated at the Show by means of a reflectometer which showed the relative reflectivities of various materials to infra-red radiation. The new insulation is applied to both flat and cylindrical surfaces and is said to be well suited for all uses ranging from cold storage rooms to boilers and steam pipes and other high temperature applications.

Improved Stills

Distilled water capacity of from 50 to 125 gal. per hr. of chemically and biologically pure water may be obtained with the new Model 80 water still recently announced by the Barnstead Still & Sterilizer Co., Forest Hills, Boston, Mass. The new still is continuous in action, fully automatic and insures the

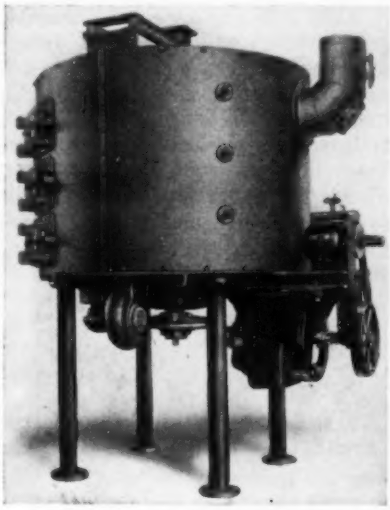
Production-size water still

purity of the product through the use of copper and brass parts throughout, with all parts in contact with the water coated with pure tin. High heat utilization is attained, it is said, by the use of counter-current condensation of the distillate which preheats the feed water to the boiling point. Other advantages of the new still include easy cleaning and compactness.

This company has also introduced a new solvent-recovery still, useful in all plants where solvents such as carbon tetrachloride, trichlorethylene, ethyl acetate, ether, alcohol, toluol or benzol are used. The still is built to suit the user's requirements and may be either continuous or batch and is made in a wide range of capacities for heating by steam, gas or electricity.

Multiple-Hearth Roaster

Two small multiple-hearth roasters, for use in the continuous processing of waste materials, have recently been announced by the Bethlehem Foundry & Machine Co., Bethlehem, Pa. The larger of the two is intended for small commercial operation and the smaller for experimental work. Each type employs three hearths with air-cooled rabble arms. Each provides for the controlled admission of oxidizing air to any or all hearths. Speed variation is possible in the case of the larger, through a variable-speed pulley drive, and in the case of the smaller, through a five-speed gear.

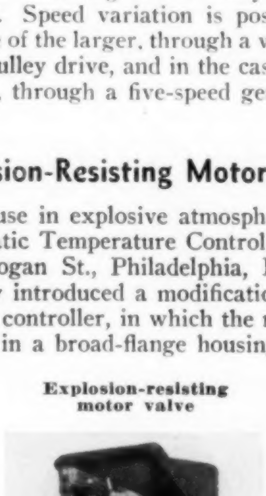


Unit roaster for small commercial operation

Explosion-Resisting Motor Valve

For use in explosive atmospheres the Automatic Temperature Control Co., 34 East Logan St., Philadelphia, Pa., has recently introduced a modification of its Type 2 controller, in which the motor is housed in a broad-flange housing, made in accordance with Underwriters Laboratories' specifications. It will be recalled that the principle of this type of explosion-resisting construction is to use broad flanges without gaskets, relying on the cooling effect of the flanges to quench any flame that might result from an internal explosion.

Explosion-resisting motor valve



MANUFACTURERS' LATEST PUBLICATIONS

Chemicals. Philadelphia Quartz Co., Philadelphia, Pa.—4-page folder describing the properties of the newest industrial alkali, sodium sesquisilicate.

Coatings. Bakelite Corp., River Road, Bound Brook, N. J.—39-page book describing and showing applications of this company's heat-hardenable varnish, enamel, lacquer and cement.

Comment. Nassau Smelting & Refining Co., 50 Church St., New York City—12 pages, first issue of a new bi-monthly booklet of comment, to be known as "Nassau" and available to consumers of non-ferrous metals.

Controllers.. Bailey Meter Co., 1050 Ivanhoe Road, Cleveland, Ohio—Bulletin 83—16 pages describing this company's thermo-hydraulic, automatic feed water regulators.

Conveyors. Stephenson-Adams Mfg. Co., Aurora, Ill.—16-page catalog completely explaining and describing applications of Redler continuous flow conveyors.

Ejectors. The Elliott Co., Jeannette, Pa.—Bulletin G-6—24 pages describing and showing applications of this company's single- and multi-stage steam-jet ejectors.

Electrical Equipment. General Electric Co., Schenectady, N. Y.—Publications as follows: GEA-612B, 56 pages on demand meters; GEA-897E, 19 pages on air-cooled transformers; GEA-1305C, 34 pages on luminous-tube transformers; GEA-1662E, trip-free air circuit breakers.

Equipment. Hardinge Co., York, Pa.—Leaflet describing a small-commercial or laboratory classifier of the rotary type.

Equipment. L. O. Koven & Bro., 145 Ogden Ave., Jersey City, N. J.—52-page catalog outlining in detail this company's extended services in the fabrication of equipment for process industries, including tanks, mixers, sheet construction, hoppers, towers, piping, kettles, etc.

Equipment. Lukens Steel Co., Coatesville, Pa.—8-page pictorial summary of the work of Lukens Steel Co. and its subsidiaries in production of plates and fabrication of equipment.

Furnaces. Hevi-Duty Electric Co., Milwaukee, Wis.—Bulletin HD-135—4 pages describing box-type furnaces.

Glassware. Kimble Glass Co., Vineland, N. J.—Form 199—64-page book describing this company's complete line of blue-line-calibrated laboratory glassware.

Instruments. Brown Instrument Co., Philadelphia, Pa.—8-page folder describing this company's mechanical and electrical flowmeters.

Lubrication. Acheson Colloids Co., Port Huron, Mich.—Technical Bulletin P-220—6 pages on graphoid surfaces and the part they play in lubrication.

Water Stills. Barnstead Still & Sterilizer Co., Forest Hills, Boston, Mass.—Folder briefly describing this company's single,-double- and triple-type water stills in capacity ranges from $\frac{1}{2}$ to 5,000 g.p.d.

Materials Handling. C. O. Bartlett & Snow Co., Cleveland, Ohio—Bulletin 74—Catalog on chains, sprockets,. buckets and accessories for materials handling.

Materials Handling. Jeffrey Mfg. Co., Columbus, Ohio—Catalog 565—111 pages with complete information on standard bucket elevator equipment for general service.

Materials Handling. The Lamson Co., Syracuse, N. Y.—21-page catalog on roller, slat and chain conveyors, elevators and pneumatic tubes.

Materials Handling. Silent Hoist Winch & Crane Co., 762 Henry St., Brooklyn, N. Y.—Bulletin 45—12 pages describing gasoline-powered wheel- and crawler-mounted swing-boom cranes made by this company.

Materials Handling.. Whiting Corp., Harvey, Ill.—Bulletin 195—4 pages describing hand- and electric-power traveling cranes.

Metals and Alloys. American Rolling Mill Co., Middletown, Ohio—Leaflet describing advantages of high finish attained in this company's stainless steels.

Metals and Alloys. Republic Steel Corp., Massillon, Ohio—Booklet 125-A—16 pages on several types of Enduro 18-8 stainless steel, with lengthy tabulation of laboratory corrosion data.

Mixing. Robinson Mfg. Co., Muncy, Pa.—Bulletin 32-D—56 pages on many types of mixer made by this company for solids and liquids.

Nozzles. Lunkenheimer Co., Cincinnati, Ohio—4 pages describing this company's lever-operated bronze air nozzles.

Packing. Alexander Bros., 406 North 3d St., Philadelphia, Pa.—24-page booklet describing this company's leather packing for hydraulic and pneumatic service.

Paint. Sherwin-Williams Co., 101 Prospect Ave., N. W., Cleveland, Ohio—"Guide to Profit Through Paint," spiral-bound booklet explaining the uses and advantages of paint and color on a unit-cost basis, with recommendations for specific uses.

Power Generation. Combustion Engineering Co., 200 Madison Ave., New York City—Catalog E-8—16 pages describing this company's Type E center-retort, underfeed stoker.

Power Generation. Worthington Pump & Machinery Corp., Harrison, N. J.—Bulletin S-500-B6D—15 pages on this company's diesel engines, 25-1,000 hp.

Power Transmission. Baldwin-Duckworth Chain Corp., Springfield, Mass.—Catalog K-1—54 pages on chains and sprockets for power transmission, conveying and elevating.

Power Transmission. Link-Belt Co., 910 South Michigan Ave., Chicago, Ill.—Catalog 1515—20 pages devoted to a newly developed line of motorized speed reducers, with engineering data and application illustrations.

Power Transmission. Power Transmission Council, 370 Lexington Ave., New York City—36-page booklet giving a practical analysis of some of the fundamentals of mechanical power transmission in relation to modern group drives.

Pumps. Allen-Sherman-Hoff Co., 225 South 15th St., Philadelphia, Pa.—Bulletin 1034—12 pages with engineering data describing this company's rubber-lined sand pump.

Pumps. Roots-Connersville Blower Corp., Connersville, Ind.—Bulletin 50-B11—4 pages describing high-duty vacuum pumps for paper mills.

Pumps. Worthington Pump & Machinery Corp., Harrison, N. J.—W-318-B4 and W-321-B3, each 4 pages, respectively covering three-stage volute centrifugal pumps and close-coupled centrifugal pumps.

Refractories. General Refractories Co., 106 South 16th St., Philadelphia, Pa.—Publications as follows: Bulletin 101, This company's refractory products and services; 201, Fireclay brick; 202, Kaolin brick; 203, Plastic firebrick; 204, Chrome-base, high-temperature cement; 205, Fireclay- and cyanite-base, high-temperature cement; 301, Metallurgical refractories; 302, Refractories for rock products industries; 303, Refractories for boiler plants, 304, Refractories for oil refineries.

Safety. Mine Safety Appliances Co., Pittsburgh, Pa.—20 pages on industrial consequences of carbon monoxide and on detection, warning, resuscitation and respiratory equipment.

Screens. Productive Equipment Corp., 210 East Ohio St., Chicago, Ill.—Bulletin 135—4 pages briefly describing features of this company's Selectro screen, adjustable to any one of several degrees of throw.

Separators. Magnetic Mfg. Co., Milwaukee, Wis.—Bulletin 300—Describing part of this company's standard line of magnetic pulleys and magnetic-pulley-type separators with complete specifications on sizes of 12 in. and larger.

Thiokol. Thiokol Corp., Yardville, N. J.—Leaflet describing this company's oil-proof synthetic rubber and another leaflet listing users of this product.

Chemical Engineering NEWS

Chemical Engineers Plan Wilmington Sessions

A TENTATIVE program for a symposium on chemical engineering laboratory design, equipment and use has been announced by Dr. Harry A. Curtis, chief chemical engineer of the Tennessee Valley Authority, and chairman of the A. I. Ch. E. Committee on Chemical Engineering Education. The meeting will be held at Wilmington, Del., May 16-17, directly following the Institute meeting. It is expected that the sessions will be attended not only by representatives of the schools and colleges in which chemical engineering is taught, but also by practicing chemical engineers, research directors and others interested in promoting better instruction in the practical application of the unit operations and processes.

Sessions are planned for Thursday morning and afternoon, followed by an informal dinner and round-table discussion in the evening. The meeting will be concluded after a half-day's session on Friday, devoted largely to a description of laboratory experiments and equipment leading up to a round-table discussion as to the feasibility of a laboratory manual.

Among the papers to be presented and discussed are the following which have been tentatively assigned to various representatives of the universities and industries: "The Objectives of a Chemical Engineering Laboratory Course," Harry A. Curtis, Harry McCormack, W. R. Veazey and A. W. Hixson; "Design and Equipment of a Chemical Engineering Laboratory," N. W. Krase, C. A. Mann, J. C. Elgin, W. L. Badger, and H. L. Olin; "Undergraduate Laboratory Projects and the Necessary Facilities," B. F. Dodge and W. G. Whitman; "The Shop Facilities for a Chemical Engineering Laboratory," J. H. Rushton and M. C. Molstad; "Unit Chemical Processes in the Chemical Engineering Laboratory Course," D. B. Keyes and R. E. Montonna; "Summary of Replies to S. P. E. E. Questionnaire Concerning Chemical Engineering Laboratory Courses," S. C. Ogburn; "Chemical Engineering Laboratory Reports," A. W. Davison; "The Chemical Engineering Laboratory in Industry," T. H. Chilton and David Pierce; "Chemical Engineering Unit Processes," D. B. Keyes; and "Correlation of Laboratory and Lectures," W. L. Beuschlein.

Further information will subsequently be available through the office of the secretary of American Institute of Chemical Engineers, Bellevue Court Building, Philadelphia, or from Dr. Harry A. Curtis, chairman, Ferris Hall, Knoxville, Tenn.

Fertilizer Trade Attempts Simplified Formulas

NINE of the zones or sub-zones into which the fertilizer industry divides its business have adopted a standard list of grades or formulas. By this means simplification of trade practice is being accomplished and a definite step taken toward economy in merchandising.

Four states of the Southwest have adopted a limited series of formulas ranging in number from 15 for Mississippi to 27 for Louisiana. Five of the Middle Atlantic areas ranging from Delaware to North Carolina have fixed their standards also, with Virginia "standardizing" on about 50 formulas. But as one critic of this long list said —"Perhaps 50 is better than the old 150, even though it is much too long a list to last."

The Southeastern states from Tennessee to Florida have not yet acted but are being prodded. The great Midwestern territory from Kentucky and Ohio to the Rocky Mountains is working on a ten-state program but necessarily slowly in view of the diversity of agronomic problems that are being met.

All plans adopted should, according to National Fertilizer Association leaders, include the provision that multiples of standard formulas containing more than 24 per cent plant food are always permissible. By including this proviso in simplified practice agreements, it is insured that these lists do not throttle the desired trend toward more concentrated fertilizers.

Exponents of this movement think of progress as in four stages: Preliminary agreement on principles, already accomplished in most areas except the Far West; establishment of a tentative list, already done for nine zones above referred to; simplification of lists to include only 20 or 30 formulas in most cases; final coordination of practice between states or zones of like agronomic situation, not yet attempted. Only with the accomplishment of the fourth stage of development can the national distributors and larger companies having regional marketing groups be most fully aided.

Export Association Formed For Carbon Black

FOR the purpose of exporting carbon black, Carbon Black Export, Inc., has filed papers, under the Export Trade Act, with the Federal Trade Commission. The association will maintain offices at 500 Fifth Ave., New York.

Officers of the association are: C. E. Kayser, president and director; Reid L. Carr, secretary and director; F. R. Cantzlaar, treasurer; E. V. Gent, assistant treasurer; Godfrey L. Cabot, Thomas D. Cabot, F. F. Curtze, Oscar Nelson, D. P. Hynes, G. A. Williams, R. H. Eagles, Hans Huber, T. J. Butler, and Robert Wishnick, directors.

Members are: United Carbon Co., Charleston, W. Va.; Columbian Carbon Co., New York; J. M. Huber Corp., New York; Century Carbon Co., New York; Panhandle Carbon Co., New York; Godfrey L. Cabot, Inc., Boston; Texas Carbon Industries, Inc., Sayre, Okla.; and The Palmer Carbon Co., Chicago.

German Dye Trust Greatly Expanded in 1934

NOTWITHSTANDING a considerable reduction in export trade the I. G. Farbenindustrie, or German Dye Trust, continued to expend large sums for modernization of existing equipment and the erection of new plants during 1934, according to a report from Frankfort-on-Main to the Department of Commerce.

This action on the part of the Dye Trust is in line with the Government's policy to make Germany as self-sufficient as possible by producing synthetically materials which must now be imported, and which at present can not be obtained in sufficient quantities owing to the shortage of exchange.

Chemical Organizations Will Celebrate Tercentenary

PLANS are practically completed for the eighty-ninth meeting of the American Chemical Society which will be held in New York during the week beginning April 22. Participants in the meeting which will celebrate the 300th anniversary of the founding of the chemical industry in this country, will include the Manufacturing Chemists Association, the Synthetic Organic Chemical Manufacturers Association, and the chemical societies of the metropolitan district.

Francis P. Garvan, president of the Chemical Foundation and recipient of the Priestley Medal as "the greatest lay patron of chemistry," is honorary chairman of the New York committee. Prof. Arthur W. Hixson of Columbia University is general chairman.

Senator Pat Harrison of Mississippi and Representative James W. Wadsworth of New York will be among the speakers at a dinner meeting on Wednesday evening, April 24. On the same day a chemical industries symposium, planned to interpret the close relationship between the chemical industries and the national welfare, will be held. Thomas Midgley, vice president of the Ethyl Gasoline Corp., will deliver an address on "Chemical Developments in the Next One Hundred Years." William B. Bell, chairman of the board of directors of the American Cyanamid Co., will speak on "National Planning and the Chemical Industries."

On Thursday, April 25, there will be a symposium on the economic problems of the chemical industry, with R. P. Soule, chemical economist of the Tri-Continental Corp., as chairman. "Machine Age or Material Age?" is one of the topics to be discussed.

Plant visits which will form one of the features of the meeting have been arranged with regard to the specialized interest of the individual visitor and to his affiliation with different scientific and technical divisions of the Society. All plans and arrangements have been made by divisional representatives who assume the responsibility for selecting plant visits of major interest and of most convenience in relation to the divisional meetings.

Chinese Chemical Industry Developed in 1934

CHINA is still essentially a consuming market for chemicals, domestic manufacture of all commodities as yet being in its infancy, according to a report from Trade Commissioner A. Viola Smith, at Shanghai. Since 1932, however, the use of heavy chemicals has been stimulated by the increased industrial activity throughout the country, especially in the Shanghai region where over 5,000 factories are operating.

In Shanghai a liquid ammonia and nitric acid plant purchased by Chinese interests from France during 1934 is now under construction and will be in production probably by July 1, 1935.

A large modern alcohol plant, erected in Shanghai in 1934 under the joint auspices of the Ministry of Industries and private overseas Chinese capital, started production in January 1935. The daily output expected is 7,150 gallons. Negotiations are also under way for the erection of Government alcohol plants at Changsha and Canton. In addition to the new alcohol plants, there are numerous small producing plants in the Shanghai region which are finding competition difficult.

A modern plant for the manufacture of oxygen and acetylene went into production at the end of 1934. Also, sulphuric acid plants established included a new factory in Honan Province, Central China, and one in South China; while the Government plant at Canton, closed late in 1933, reopened in April 1934, and continued to operate on full time.

A caustic soda and bleaching powder plant and an anhydrous ammonia plant in course of erection in Canton are scheduled for completion in 1935. The reported establishment of a Japanese plant in Dairen for the manufacture of ammonium sulphate and other chemicals is capitalized at 25,000,000 yen, and the estimated capacity is 180,000 tons annually. Negotiations are also under way for the erection of ammonium sulphate plants at Pukow, near Nanking, and at Canton, but completion is not anticipated prior to the summer of 1936.

Chinese interests have established sulphur black plants, mainly at Shanghai, where a new one went into operation in 1934, in addition to two started in 1933.

Bohn Corporation Plans Pilot Plant

ACCORDING to an announcement from Charles B. Bohn, president, the Bohn Aluminum & Brass Corp. is negotiating for hydroelectric power for the extraction of aluminum from alunite. The announcement says that as soon as the power question has been satisfactorily settled, the Bohn organization plans to build a pilot plant at Detroit to cost $50,000. This will have a capacity of 20 tons a day. Data from its operation will be used as a basis in designing an eventual manufacturing plant. Potash and sulphuric acid as byproducts of the Bohn process were stressed in earlier announcements but no details have been made public.

Engineers Plan to Advance Professional Status

METROPOLITAN sections of five national engineering societies, representing civil, electrical, mechanical, chemical and mining engineers, met on the evening of March 6 in the auditorium of the Engineering Societies building, New York, to hear four eminent engineers discuss the aims and achievements of the Engineers' Council for Professional Development. The Council is a conference of engineering bodies organized to enhance the professional status of the engineer through the cooperative support of national organizations dealing with various phases of an engineer's life. Gano Dunn, president of the J. G. White Engineering Corp., and recently elected chairman of the board of trustees of Cooper Union, presided. The speakers were Dr. C. F. Hirshfeld, chairman of the Council and chief of research of the Detroit Edison Co., General R. I. Rees, chairman of the Council's committee on professional training and assistant vice-president of American Telephone and Telegraph Co., and Prof. J. W. Barker, member of the Council's committee on professional recognition and dean of the school of engineering of Columbia University.

The ultimate aim of the Council, it was explained, is to establish recognized criteria for the use of the professional title of engineer. At present there are no uniform standards, although many of the states have adopted a system of licensing engineers by examination.

Germany Recovers Sulphur From Coke-Oven Gas

THE quantity of sulphur obtained in Germany as a byproduct of coke-oven gas has been increased to 15,000 metric tons per annum by the recent erection of two new units, according to a report from Consul Sydney B. Redecker, Frankfort-on-Main.

Recovery of sulphur from fuel gases, a development of the past two years, is in line with the German Government's policy of making the country as self sufficient as possible by producing materials which must now be imported.

The leading factor in this development has been the Ruhr Gas A. G., a joint cooperative gas distributing subsidiary of a large number of Ruhr coke plants, which two years ago began production at coke-ovens of the United Steel Works by a process developed by the I. G. Farbenindustrie. The output of this plant is 7,000 metric tons per annum of sulphur of all degrees of purity. A similar plant in operation at Hamborn produces 2,500 metric tons and another is to have its capacity increased from 1,000 to 3,000 metric tons.

NEWS FROM WASHINGTON

By PAUL WOOTON

Washington Correspondent of Chem. & Met.

NEW DEAL pride, rather than fundamental New Deal progress, has been hurt by the numerous adverse decisions in conspicuous court cases lately. Thus far these decisions are limiting certain types of Alphabetic activity; but they do not upset the bandwagon nor even divert it seriously into byways. Only in the event that the Supreme Court should undertake a most unexpectedly sweeping condemnation of regulatory effort by the Federal Government would there be a chance to stop altogether N.R.A., A.A.A., P.W.A., T.V.A., and like New Deal activity.

Most important to chemical industry is perhaps the T.V.A. ruling of Judge Grubb in the Federal District Court at Birmingham. That decision definitely enjoined power companies and municipalities from proceeding with Government-ownership plans. The basis of injunction was that the Federal Government had never been accorded by the states the Constitutional privilege of going into such business. The judge ruled, therefore, that procedure to municipalize electrical distributing facilities on the assumption of T.V.A. power supply was beyond the privileges constitutionally available to a government-owned corporation.

T.V.A. is continuing substantially all of its previous activities and can do so under the court ruling since, in a technical sense, the judge's findings were not addressed to T.V.A. itself. The injunction lies only against municipalities and the power company involved in the suit. It is noticeable, however, that T.V.A. is now laying emphasis on navigation, water control, and "interstate commerce" activities, with a conspicuous silence surrounding its social reform efforts. But the reform efforts have not ceased.

Final decision of the right of a government agency to generate and sell power as a matter of social policy will be settled only when the Supreme Court has acted. A sufficient element of doubt has been created so that even the proponents of socialization of industry are not now seeking movements in this direction. It is clear that it would be still more difficult for the Government to defend the manufacture of fertilizer for sale commercially than it would be to demonstrate the reasonableness of developing power as a part of waterway control. Hence it was inevitable that T.V.A. should decide for this year at least not to sell commercially the fertilizer made at Muscle Shoals. The bulk of this will go into demonstration farms, for agronomic research, and other related projects. (See *Chem and Met.*, Feb. issue, p. 86.)

Like all business, chemical industry is much concerned with the chaotic legislative situation which has prevailed in Washington since presidential domination of Congress broke down. Formerly it was enough to be sure that a proposed bit of legislation had administration support to forecast its enactment with reasonable promptness. Now the administration label is not altogether an asset.

Best informed Washington anticipates that before Congress adjourns at least the following measures will have been enacted:

(1) The extension of N.I.R.A. for at least one year, probably for the requested two years.

(2) A general banking act with largely increased power for the Federal Reserve system making it virtually a central bank in power, though far from that in name or nominal form.

(3) A portion of the social reform legislation, including particularly unemployment insurance and old-age pensions.

(4) A bill drastically regulating public-utility holding companies, but not nearly as far reaching in abolishing these companies as the radical wishes of some have suggested.

(5) A work relief measure with some earmarking of appropriations, but ample freedom for planning by the Executive.

(6) A new tax bill, in form and application at present far too vague to warrant forecasting.

(7) Some amplification of A.A.A. authority.

(8) A veterans' bonus settlement, definitely a compromise but probably costing the Treasury over a billion dollars.

(9) Labor legislation, probably including some limitation on the work week, a compromise between the 30-hour week bill and the negotiated N.I.R.A. limitations. Forty hours as the average work week is now discussed by Congressional leaders as probable, with attempt at legislative exemptions for certain types of work, certain geographic areas, and certain specialized industries. Penalties of extra pay for overtime work would probably be used in part, with absolute work limits being set well over 40 hours to secure allegiance of those who are unalterably opposed to any low absolute limit.

Assumption of federal control of interstate watersheds for the purpose of abating stream pollution will be proposed in Congress shortly unless Senator Lonergan of Connecticut is assured that the National Resources Board's current investigation will head up in definite recommendations for an effective attack on the problem. Interior Secretary Ickes recently appointed an advisory committee on stream pollution as an adjunct of the national board and H. R. Crohurst, sanitary engineer of the Public Health Service, was assigned to the board with instructions to prepare a report within 60 days recommending a policy to be pursued in future. Senator Lonergan has written to Secretary Ickes stressing the desirability of getting action.

The interdepartmental conference that, under the chairmanship of Secretary of War Dern, went on record last December in favor of the federal control plan, asserting that the subject already has been investigated nearly to death, while efforts to deal with the problem under divided jurisdiction have proven ineffective.

Under Senator Lonergan's bill the National Resources Board or a similar agency would be vested with jurisdiction over all navigable waters and their tributaries from which pollution is carried or washed. The board would have authority to create sanitary water district boards which would be empowered to require installation of sewage disposal plants and treatment works for industrial plants and to arrange for the financing of such installations. The profit from any byproducts recovered in such trade waste treatment plants would revert to the district authority until such time as the plant is paid for.

An appropriation of $18,000 for the Government's helium plants near Amarillo, Texas, is barely sufficient to provide for routine operation of the field. The request of the Bureau of Mines for $50,000 to cover the drilling of a new well and the repair of two others was rejected by the House Committee on Appropriations on the ground that helium production is of decreasing importance due to the practical failure of the lighter-than-air ship as a military or naval asset. The committee's attitude was expressed in hearings on the proposed 1935-36 budget of the Bureau of Mines, Jan. 31, prior to the Macon disaster.

Five existing wells are not sufficient for proper development of the field and

two of them are in such bad condition, according to Joseph H. Hedges, assistant to the Director of the Bureau, that $2,000,000 worth of property is endangered. Repairs are necessary to protect the field from loss of gas and infiltration of water. The expense of field operation does not represent a charge on the Government as it is covered by the sale for commercial purposes of residue gas, after processing for removal of the helium content. The appropriation of $50,000 sought by the Bureau represented the unappropriated balance of receipts during the current fiscal year ($18,000) plus estimated receipts of $32,000 in the fiscal year 1936. The House Committee limited next year's appropriation to the unexpended balance of this year's receipts and also eliminated a request for a direct appropriation of $6,494 to resume a survey of helium resources which lapsed in 1933 because of lack of funds.

New Products Obtained From Wood Distillation in Germany

From Our Berlin Correspondent

LATE improvements in the wood distillation industry have resulted in production of new materials as well as higher recovery of products formerly extracted from the tar, with the result that the tar has now become an important raw material in the synthesis of many technical products. It has, for instance, been possible to produce pure 95 to 97 per cent creosol (4-oxy-3-methoxy-1-methylbenzene, boiling point 221 deg. C.) and ethyl guaiacol (4-oxy-3-methoxy-1-ethylbenzene, boiling point 230 deg. C.). These formerly not used derivatives of guaiacol have pharmaceutical properties similar to those of guaiacol itself; they are also closely related to vanillin. Pyrogallol-1, 3-dimethyl ether, melting point 55 deg. C., predominates among the higher boiling tar fractions and is now available in large commercial quantities (Holzindustrie, A. G., Constance) for production of cerulein, syringic aldehyde, dyes, pharmaceuticals, or oxy or amino derivatives for photographic developers. Finally, pyrocatechin in commercial quantities, formerly made only from vinegar, may also be made from the wood tar. A material which lately is being made in increasing quantities from wood tar is methyl cyclo-pentanol ($C_6H_8O_2$), a volatile, easily sublimated substance with a distinct nut flavor related to jasmone (jasmin oil); this compound also possesses pharmaceutical properties.

To detect underground pipe lines, the course of which has not been definitely mapped, Siemens has developed a new apparatus which should eliminate much unnecessary excavation where repairs have to be made. Where only a valve or meter of the line is available this is connected with one pole of a detector with ear phone attachment, while the other pole is grounded where the line is expected to be. If an a. c. current of 800 cycles per sec. is passed through the pipe line a distinct hum may be heard in the ear phones, whereby the exact location of the line may be determined.

An indication of the efforts made to develop domestic motor fuels may be furnished by the fact that three new benzene plants are being built at the Berlin municipal gas plant, one of which, with a daily capacity of 250,000 cu.m., uses the benzorbon method (activated carbon), while the two others employ scrubbing the gas with wash oil; a good comparison of the recovery and economy of the two processes should be obtained. Tests are also being made of improving the recovery of benzene from gas in the Still process, by drawing the gas from the interior of the chamber ovens. Removal of poisonous carbon monoxide from city gas is another new development. Tests have also been conducted by the gas works and a transfer company in Berlin, to operate auto buses with compressed city gas, and based on the results obtained all city buses may be running on gas within the next two years.

As German iron ore mines now in operation do not yet supply one-third of the country's requirement, efforts are being made to utilize the low-grade domestic ores now of no commercial value. The chlorine method developed for this purpose has already been described (*Chem. & Met.* Vol. 42, No. 2, p. 110). In the Krupp "Renn" process, which may be used for ores with 25 per cent iron, the ore is mixed with fuel such as coal dust, coke breeze, or coke from coal distillation plants and treated in a revolving kiln with about 30 parts of fuel per 100 parts of ore. Incidentally the process may present a new outlet for distillation coke. The reduced metal, discharged as lumps imbedded in the slag, is recovered by crushing the slag to 10 mm. mesh followed by screening. Metallic particles of less than 1 mm. size are removed from the slag by magnetic separation and charged back to the furnace.

According to results obtained by Johannsen, in two kilns, 90 to 96 per cent of the iron contained in the ore may be recovered as lumps containing 97-99 per cent iron and 0.5 to 1.5 per cent carbon. In the treatment of an ore with 39.3 per cent iron by ordinary wet concentration methods a recovery of 63.6 per cent of the iron was attained at a cost of 57.50 Rm. per ton of iron, while the new method showed a recovery of 94 per cent at a cost of 38.50 Rm. This saving is attributed to the low consumption of fuel and limestone, and to the ease of melting the lumps in the blast furnace.

The metal policy of the Government inaugurated last summer has resulted in a great decrease in imports of unfinished metals, as may be seen from the following tabulation of the imports for 1934:

	First Quarter Metric Tons	Second Quarter Metric Tons	Third Quarter Metric Tons	Fourth Quarter Metric Tons
Copper	58,000	67,250	31,366	23,600
Tin	3,940	4,100	2,550	2,900
Zinc	34,640	41,430	16,567	14,600
Lead	14,970	23,680	7,420	2,480

Increased use of domestic supplies and better planning in fabrication will permit Germany to reduce imports of unfinished metals still further. Imports from the United States during last year were 49,640 tons of copper and 4,330 tons of lead.

Rotosil and Homosil are two new materials developed by Heraeus; the former is used in the production of tubes, dishes, and crucibles. Hollow articles of this material are produced by using the melting charge as lining in a hollow revolving form, in the center of which is placed the electric resistance or the electric arc used to supply the heat of fusion. Before applying the heat the form is revolved at a speed that will insure even distribution of the fused material on the inside of the form. The objects produced by this method have a very smooth inner surface, and the material, which is opaque, has the same resistance to chemical attack and heat and temperature changes as ordinary quartz glass. Its mechanical properties, however, are superior to those of quartz glass, on account of the freedom from pores of the smooth inner surface, and it is also better suited for high-tension electrical insulators. The direct method of production also results in low fabricating costs, and the articles can also be made in considerably greater dimensions than is practicable with ordinary quartz glass.

Homosil is a clear quartz glass for optical purposes, made in the shape of plates, lenses, and prisms, which are practically free from double refraction and from streaks. This is attained by kneading softened rods of the material in a furnace, between moving rods.

British Chemical Industries Show Gradual Expansion

From Our London Correspondent

BRITISH Chemical Industries continue to show slow but steady expansion and reasonably satisfactory results, these being not only in slightly increased dividends, but also in new developments and extensions of plant. This will no doubt be confirmed by the annual reports of firms like Imperial Chemical Industries, which will probably follow the example of Courtaulds Ltd. by making a slightly increased distribution in spite of the fact that the price of soda ash has recently been lowered. This is partly due to foreign competition and particularly imports from Russia, which has since been dealt with reasonably satisfactorily.

The Chemical exhibits at the British Industries Fair which has just concluded, were on the usual lines, and call for no special comment. The Plastics industry shows continued signs of expansion, and has shown several new products, including a transparent glass-like material made by I.C.I., who incidentally has recently come to an understanding with British Cyanides Ltd. in regard to the patent situation for aminoplastics.

The protracted patent litigation between Courtaulds and British Celanese has been previously referred to in these columns, and the issue has now been fianally settled by the dismissal of the appeal in favor of Courtaulds Ltd., the result being that all four patents upon which British Celanese relied have been declared invalid. This decision is of obvious importance, inasmuch as the number of patents still standing in the name of British Celanese is very large and their value was previously assumed to be considerable. Some sympathy may be expressed for British Celanese, inasmuch as they were undoubtedly pioneers and turn out a first-class product, and it seems a pity that litigation was resorted to in this particular case especially as further litigation may follow in other countries, including America, in spite of the adverse decision.

The essential feature of the present judgment was the rejection of the contention that the mere placing side by side of known integers so that each performs its own function is not the subject of a patentable combination, unless they have a working interrelationship producing a new or improved result, thereby giving patentable subject matter. Explanations were given in the judgment, as to why this could not apply in the present issue. In addition, the Court found that there was want of novelty, and that what was done was obvious to any one skilled in the art. Some criticism was also made of the undue time taken up by the examination of experts during the hearing, and to the irrelevance and inadmissibility of some of their evidence. The general view is that this applied mainly to the experts called by British Celanese, but it is not unlikely that steps will be taken to reduce to the essential requirements, the evidence of such witnesses in future cases. It is only rarely in this country, that a qualified technical assessor is called in to sit with the judge.

An interesting report is published in the "Gemmologist" London, of this month, based on publication in a German paper of the recent results in the I.G.'s Works in the manufacture of synthetic emeralds. This work was carried out at Bitterfeld, where synthetic rubies and sapphires have been commercially produced for many years, but although this may convince people on the Continent as regards the success obtained, it is reported that the "Igmeralds" as they are called, can be distinguished by scientific means from the natural stones, and that so far at any rate, and in spite of many years of effort, nothing has yet been achieved which is likely to upset the market in natural emeralds.

New Standards Proposed For Grading Rosin

ON July 16 a hearing will be held at the office of the Food and Drug Administration in Washington, on the subject of modification of standards for rosin. It is proposed to assemble the standards in a more solid manner.

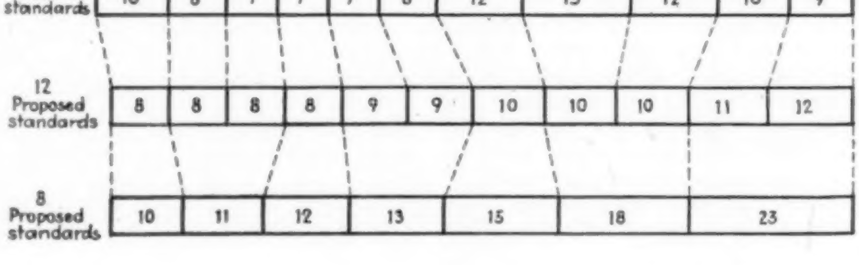
The accompanying graph represents the scale of colors of rosin of various grades, yellow being at the left end of the scale and red at the right end. Each unit indicates a color difference just perceptible to the eye. The positions of the heavy vertical lines on the first diagram on the chart indicate where the colors of the present rosin standards fall on this scale, and the number of units between these lines represents the color difference between standards. It will be seen that the location of the present rosin standards on the diagram does not give color differences between standards which follow any definite order, and it is believed that the interests of the trade would be better served by a more orderly division of the color scale among the various grades.

Russian Apatite Does Not Offer Unfair Competition

IMPORTATION of Russian apatite by Amtorg does not constitute an unfair method of competition under Section 337 of the 1930 Tariff Act, according to a decision by the U. S. Court of Customs & Patent Appeals, although the flotation processes employed in Russia by United Chemical Industries may be identical with the Broadbridge and Trotter patents owned by Minerals Separation North American Corp. The court's decision reversed the Tariff Commission's findings which recommended embargo of the Russian product on a joint complaint filed by the Phosphate Recovery Corp., American Cyanamid Co. and International Agricultural Corp.

The American patentees have no patents from the U.S.S.R. and the court held that the protection afforded by patents under American law is confined to the United States. Pointing to the distinction between product and process patents, the court found that there is no infringement of the patented process by sale in the United States of the imported product as the product itself is not patented. The rights of the parties rested solely on the patent laws as in the act of importation there was no element of unfairness.

Present and Proposed Color Standards for Rosin



NAMES in the News

D. F. J. LYNCH, chemist in Department of Agriculture, left Washington recently for Hawaii, where he will supervise manufacture of alpha cellulose from cane sugar bagasse by a process which he developed there last summer.

R. A. WITHERSPOON, formerly vice-president and general manager of Shawinigan Chemicals Ltd., has been elected president of the company.

J. J. MORGAN, of the chemical engineering faculty of Columbia University, is on a sabbatical leave. Professor Morgan plans to travel through Southern and Western states.

C. C. HERITAGE has been reelected president of the Technical Association of the Pulp and Paper Industry.

A. HERMAN, chief chemist for Seagram Distillers Corp., has transferred his office to the plant of Joseph E. Seagram & Sons, Inc., Lawrenceburg, Ind.

KARL BOENNINGHOFEN has joined the Minor Laboratories. He was formerly with the Victor Manufacturing and Gasket Co.

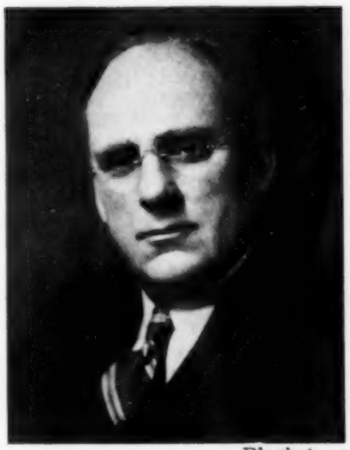
G. J. FINK of the National Aluminate Co. has been elected chairman of the Chicago Section of the American Institute of Chemical Engineers.

J. P. MCKENZIE, who received his Ph.D. degree from the University of Chicago last June, has joined the Marko Products Corp. of Chicago.

HAROLD O. WILES has accepted a position at the University of Chicago. Dr. Wiles will work under Dr. H. G. Wells in the department of chemical pathology.

DAN HAYES, recently of the University of Iowa, has accepted a position with the American Rolling Mills Co., Middletown, Ohio.

EDGAR E. LUEBKE, chemical engineer from Iowa State University, has joined the Tobin Packing Co. at Ft. Dodge, Iowa.



Blackstone

Arthur W. Hixson

ARTHUR W. HIXSON, professor of chemical engineering at Columbia University, is general chairman of the American Chemical Industries Tercentenary celebration.

LARRY JONES has become associated with the Burgess Battery Co., Freeport, Ill.

A. E. MARSHALL sailed for a European business trip on February 2. During his visit in England the president of the American Institute of Chemical Engineers will be the guest of honor at dinner of the English engineers.

A. C. MICHAELS, general foreman of the mechanical goods department of the Akron factory of Goodyear Tire and Rubber Co., has been appointed to the position of general superintendent of the Gadsden, Ala., factory. Mr. Michaels is a chemical engineering graduate from Ohio State University. He has been connected with the efficiency, inter-plant relations and development departments of Goodyear.

WALTER G. WHITMAN, head of the department of chemical engineering of the Massachusetts Institute of Technology, has been appointed to the Advisory Committee on the Chemical Engineering Series of texts and reference books published by the McGraw-Hill Book Co. Professor Whitman succeeds the late Col. William H. Walker.

OBITUARY

OSCAR J. FROST, chemist, died in St. Luke's Hospital at Denver, Colo., February 5, of pneumonia. He was born at Almond, Wis., 75 years ago.

FRANK L. JOHN, retired superintendent of the New Orleans plant of the Standard Oil Co. of Louisiana, died February 18, of pneumonia at his home in New Orleans. He was 66 years of age. Mr. John had been associated with this Louisiana organization for more than 37 years.

CHARLES H. PEEP, of the Rohm & Haas Co., Philadelphia, died unexpectedly February 27 in a hospital in New York, following a cerebral hemorrhage sustained while attending a meeting. He was 42 years old. Dr. Peep was an authority on insecticides and disinfectants and was a member of the board of governors of the National Association of Insecticide and Disinfectant Manufacturers. He was a co-author of the Peep-Grady method for testing insecticides.

G. L. HARRISON, retired chemical manufacturer of Philadelphia, died in that city March 6. He was in his hundredth year. In 1905 he retired from active business and in 1918 his company was conveyed to E. I. duPont de Nemours & Co.

CALENDAR

ELECTROCHEMICAL SOCIETY, annual meeting, New Orleans, Mar. 21-23.

AMERICAN CHEMICAL SOCIETY, New York, week of Apr. 22.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, spring meeting, Wilmington, Del., May 13-15.

AMERICAN ASSOCIATION OF CEREAL CHEMISTS, annual meeting, Denver, June 4.

CANADIAN CHEMICAL ASSOCIATION, annual meeting, Kingston, June 4-6.

AMERICAN ELECTRO-PLATERS' SOCIETY, annual meeting, Bridgeport, Conn., June 10-14.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, Detroit, June 24-28.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY, fall meeting, Atlantic City, week of Sept. 16.

EXPOSITION OF CHEMICAL INDUSTRIES, New York, week of Dec. 2-7.

Chemical ECONOMICS

RELATIVELY high rates of manufacturing operations in January can now be more definitely expressed as data for many industries become available. According to the Federal Reserve Board business activity in January reached the highest level of any time since the midsummer boom of 1933.

The board's index of industrial output rose to 90 per cent of the 1923-25 average last month following the sharp rise in the index in December to 86.

The January level of 90 compared with activity of 91 per cent in August, 1933, and the previous high January figure of 106 in 1930 when business was beginning its long descent.

"Industrial output which had showed rapid growth in December, increased further in January," the board said. "Activity in the building industry continued at a low level. Wholesale commodity prices advanced considerably during January and the first half of February, reflecting chiefly marked increases in the prices of live stock and live stock prices."

Detailed reports from the chemical industry and from industries which are large consumers of chemicals indicate that the output of chemicals in January was in keeping with the gains reported for general business. Some slowing up was reported in February with a good call for contract deliveries of chemicals reported in the early part of March.

The automotive industry has been a factor in increasing demand for chemicals in the last three months. In the first place, production in January was unusually large for that month, February production was more than 20 per cent higher than in January and March production schedules indicate an increase of about 10 per cent over that for February. For the first quarter of this year, automotive production should figure out at about 40 per cent above that for the first quarter of last year with consumption of chemicals in that industry showing a similar increase.

Producers of rayon started the year with operations at capacity and shipments in January are reported to have reached a total of 21,000,000 lb., which is about 5,000,000 lb. in excess of shipments in any previous month. This rate of shipment was maintained over a good part of February, and early March reports were also optimistic.

Textile Industry Improves

The textile industry has shown progress this year as regards consumption of cotton, silk, and wool. Definite figures later than for January are not yet available. In January consumption of all cotton in domestic mills totaled 546,787 bales. This was the heaviest consumption for any month since August, 1933, when 589,000 bales were consumed, and the largest for a January since 1930. It compared with 508,000 bales in January, 1934; 470,000 in 1933, 435,000 in 1932, 450,000 in 1931, and 576,000 in 1930. In December consumption of cotton in United States mills amounted to 413,535 bales.

Consumers of scoured wool in January averaged 5,549,000 lb. weekly, according to statistics issued by the Department of Commerce. Of this total 5,135,000 lb. were of domestic origin, 390,000 lb. duty-paid foreign and 24,000 lb. free-foreign. The average weekly consumption in December was 4,428,000 lb. scoured, while the weekly average from July, 1934, to January, 1935, inclusive, was 3,403,000 lb. scoured.

Consumption of silk in January, as measured by deliveries to mills, amounted to 47,443 bales compared with 40,942 bales in January, 1933.

Fertilizer tax tag sales in the twelve southern states, as reported to The National Fertilizer Association, represented an aggregate of 317,764 tons in January. This was a decline of 41,110 tons, or 11 per cent, from January, 1934, when sales were at an unusually high level. January sales in 1934 accounted for 10.1 per cent of the year's total, whereas in the three years immediately preceding they had averaged only 7.3 per cent of the annual sales.

Good Outlook for Fertilizers

Trade advices, however, are optimistic regarding the outlook for fertilizers this season. High prices for live stock and farm products are expected to prove stimulating and there are indications that buying outside the southern states will be on a scale larger than usual.

Consumption of crude rubber by manufacturers in the United States in January amounted to 47,103 long tons, compared with 36,662 long tons for December, 1934, according to The Rubber Manufacturers Association. Consumption for January, 1934, was reported to be 39,284 long tons.

Various reports are current relative to distribution of pigments. In some cases, demand has not been heavy while other pigments have found a much wider market than they did a year ago. Larger buying from the rubber trade has helped in the movement of zinc oxide. Titanium oxide is moving steadily into consumption and apparently is cutting in on the field of other pigments. For the first two months of this year, sales of carbon black are reported to have been about 75 per cent higher than they were in 1933.

Daily average crude petroleum runs to stills for January, 1935, were 2,434,000 bbl., a decline of 17,000 below average crude runs in December, 1934, but were 124,000 bbl. higher than the daily average runs in January last year.

Sales of paint, varnish, and lacquers in January were valued at $21,528,830 compared with $20,600,562 in January last year.

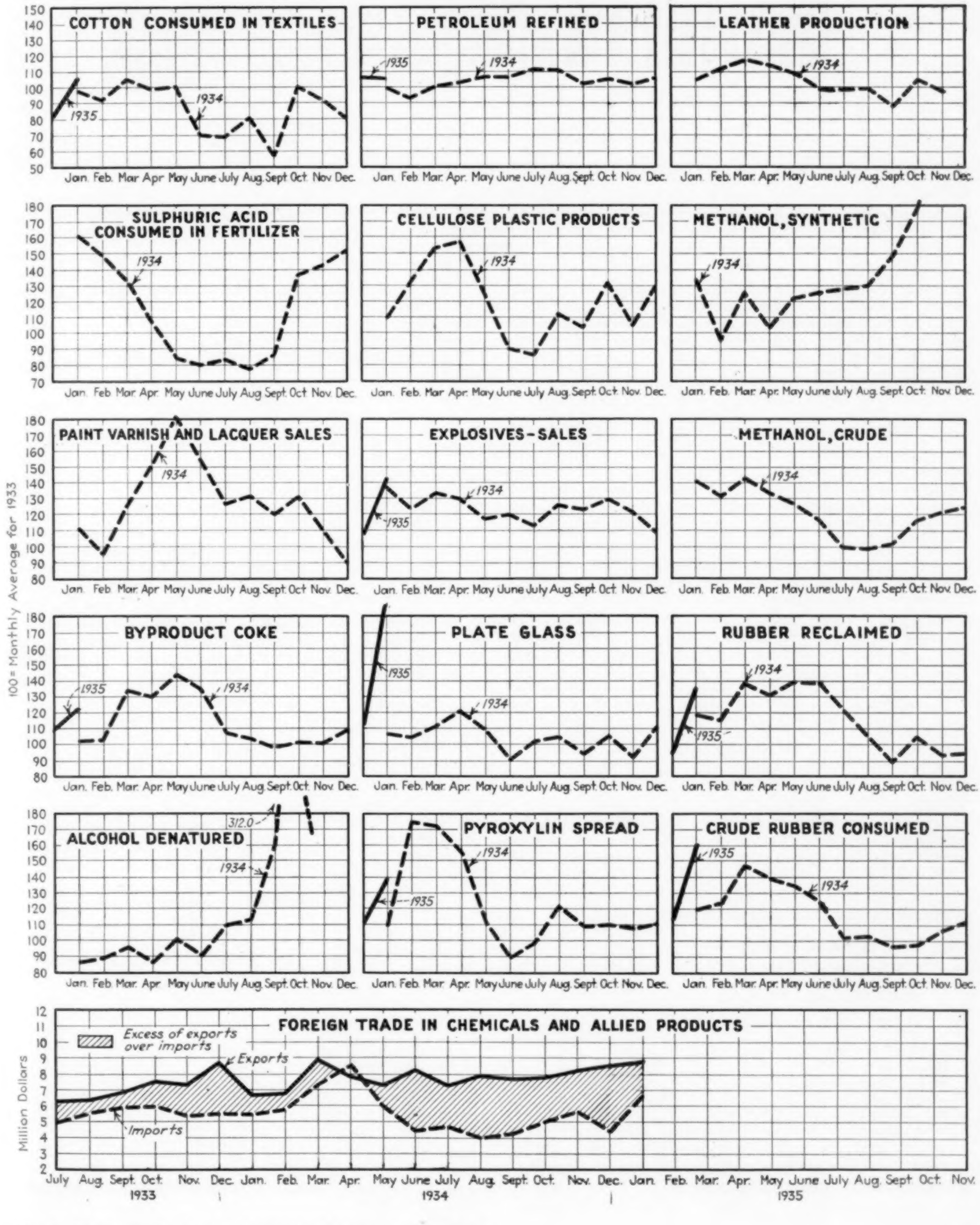
In the accompanying table figures for production and consumption are given for branches of the chemical-producing and chemical-consuming industries. Comparison is offered between the month for which latest figures are available, the preceding month, and the corresponding month of last year.

Production and Consumption Data for Chemical-Consuming Industries

Production	Jan. 1935	Jan. 1934	Dec. 1934	Per Cent of gain Jan. 1935 over Jan. 1934	Per Cent of gain Jan. 1935 over Dec. 1934
Automobiles, No.	292,765	156,907	183,187	86.6	59.8
By product coke, 1,000 tons	29,147	28,504	22,635	2.3	28.2
Glass containers, 1,000 gr.	2,935	2,770	2,922	5.9	0.04
Plate glass, 1,000 sq.ft.	13,365	7,607	7,922	75.7	68.7
Cottonseed oil, crude, 1,000 lb.	123,708	145,007	128,872	14.7*	4.2*
Cottonseed oil, refined, 1,000 lb.	110,283	109,978	129,487	0.03	15.7*
Pyroxylin spread, 1,000 lb.	4,214	3,283	3,337	28.3	26.3
Rubber reclaimed, tons	10,465	9,238	7,353	13.3	42.3
Consumption					
Cotton, 1,000 bales	547	508	414	7.7	32.1
Silk, bales	47,443	40,942	40,941	15.9	15.9
Wool, 1,000 lb.	58,370	35,968	57,065	62.3	2.3
Explosives, sales, 1000 lb.	29,147	28,504	22,635	2.3	28.2
Rubber, crude, tons	47,103	39,284	36,662	19.9	28.5

*Per cent of decline.

TRENDS OF PRODUCTION AND CONSUMPTION



The MARKETS

DELIVERIES of some of the most important chemicals against contracts have been quite heavy since the first of the year. Typical cases may be cited in the case of shipments of caustic soda to the rayon and glass trades. As a result of activity in different consuming lines, the movement of chemicals from producing points was considerably higher than in the corresponding month of last year. This condition continued for the greater part of February with some falling off in the latter part of the month. Favorable reports have been heard regarding activities in the present month and it is evident that the chemical market for the first quarter of the year will make a favorable showing with that for the first quarter of last year.

Recent trading has developed no decided price tendencies. For the greater part values are established on a steady level with a few products, such as the metal salts, varying according to the influence of the metal markets, and a few subject to competitive conditions. Among the price developments of the month was an announcement that corroders had discontinued the granting of discounts on sales of white lead and other lead products. It was a change in method of quoting rather than a change in price. A new method of quoting calcium chloride also was put into effect. The new method sets up geographical zones with prices on a delivered basis varying according to zone.

The price steadiness reported for chemicals is in sharp contrast to that noted in the market for vegetable oils and animal fats. Practically all vegetable oils have continued on a rising price scale and crude cottonseed oil sold at 10½c. a lb. in spite of heavy importations of foreign oil which have been made possible by the high prices reached in domestic markets. Tallow also made a new high and other animal fats were firmer. In consequence the weighted index number for oils and fats is higher than it has been at any time since 1929.

One of the most important developments of the month consisted in the establishment of a futures market for trading in crude petroleum and in gasoline. Trading opened on March 5 with the Commodity Exchange, New York, as the seat of trading.

The contract unit in crude oil is 2,000 bbl. of 42 U. S. gal. each on the basis of measurement at 60 degrees Fahrenheit. The base grade is Oklahoma-Kansas crude of 36.0-36.9 A. P. I. gravity, with price fluctuations in multiples of one-quarter cent a barrel. In gasoline, the contract unit is 42,000 U. S. gal., the basic grade being U. S. motor gasoline as per federal specification VV-G-101, within the range of 55-59, inclusive, octane numbers; other deliverable grades are 60-64 octane, at ¼-cent over the contract price, and 65 octane and above, ½-cent premium above the contract price. The minimum fluctuation is .01 cent per gallon.

On both crude and gasoline the first delivery month is June, 1935, with March trading limited to contracts for delivery in June and the eight succeeding calendar months. Deliveries are to be made only from storage tanks licensed by the Exchange. Crude oil deliveries in the Houston-Galveston, Texas, area or in the Cushing-Drumright area, Oklahoma, are to be made at the contract price for the basic grade, with premiums and/or discounts for other grades. Gasoline deliveries in Houston-Galveston area are to be made at contract price and in the port of New York at premium of 1/16 of one cent per gallon above the contract price.

Official figures indicate that imports of sodium sulphate declined last year. This was true for salt cake, anhydrous sodium sulphate, and glauber salt. Imports of salt cake amounted to 80,090 tons compared with 88,633 tons in 1933. Of the 1934 total Germany supplied 56,491 tons, Belgium, 15,887 tons, Canada, 3,256 tons, Netherlands, 3,245 tons, Chile, 947 tons, and Soviet Russia, 237 tons. The greater part of this material came in through southern ports with New Orleans customs district reporting 25,594 tons, Mobile, 20,347 tons, Florida, 15,185 tons, Maryland, 3,300 tons, and Galveston, 1,672 tons. Pacific coast arrivals amounted to approximately 10,000 tons and there were 6,778 tons for Dakota district.

Advices from Washington state that an amendment to the Silver Regulations making it now unnecessary for persons to file reports pursuant to such regulations with respect to the acquisition, importation, or disposition of silver salts has been ordered by Secretary of the Treasury Morgenthau with the approval of President Roosevelt. The amendment merely adds silver salts to the list of silver derivatives in section 22 of the regulations which are exempted from the report provisions. In the amendment it is pointed out that it can be modified or revoked at any time.

Vigorous efforts of the Government operated camphor trust of Japan to break into the United States market for that product are reflected in figures on imports of that product during the past two years. The United States imported 4,746,468 lb. of camphor valued at $1,474,160 during 1934, as compared with 4,498,982 lb. with a value of $1,117,386 in 1933. But, the increase in poundage was confined entirely to imports of natural crude camphor, coming from Japan, while imports of synthetic camphor from Germany dropped close to 25 per cent. Foreign trade observers believe that Japan has materially increased production and lowered prices in an effort to beat down the price of synthetic camphor and to fight domestic producers of the product.

CHEM. & MET.
Weighted Index of
CHEMICAL PRICES

Base = 100 for 1927

This month	87.63
Last month	87.60
March, 1934	88.86
March, 1933	84.76

Price changes for chemicals in the last month were of minor importance with practically all of the important commodities holding an unchanged position. Spirits of turpentine reached a slightly higher average.

CHEM. & MET.
Weighted Index of Prices for
OILS AND FATS

Base = 100 for 1927

This month	99.02
Last month	90.94
March, 1934	56.30
March, 1933	42.26

Another sharp advance in prices took place during the month. Higher prices were practically general for oils and animal fats. Foreign oils were notably stronger including Manila coconut oil. Crude cottonseed oil reached the 10½c. level.

Current PRICES

The following prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to March 14.

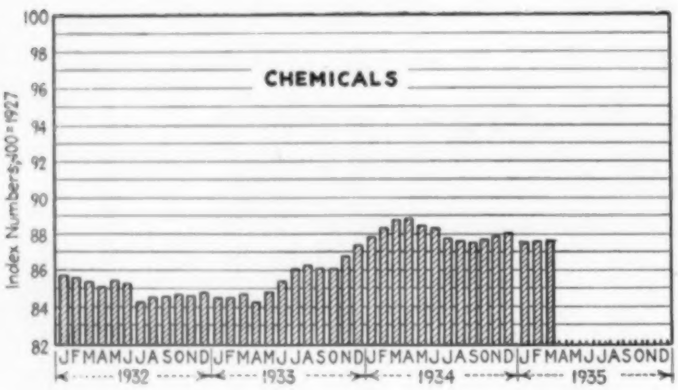
Industrial Chemicals

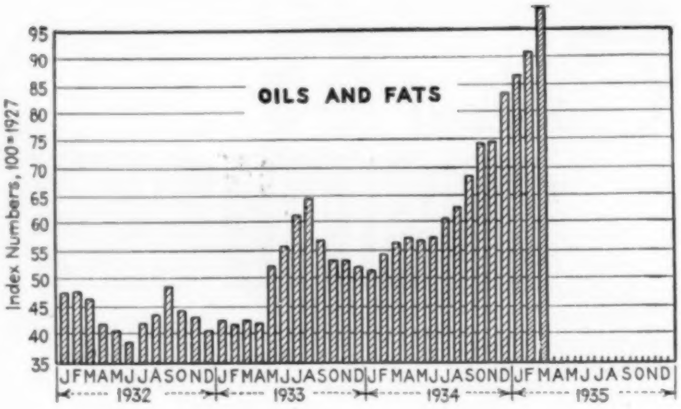
	Current Price	Last Month	Last Year
Acetone, drums, lb	$0.12 –$0.12½	$0.12 –$0.12½	$0.11 –$0.11½
Acid, acetic, 28%, bbl., cwt	2.40 – 2.65	2.40 – 2.65	2.90 – 3.15
Glacial 99%, drums	8.25 – 8.50	8.25 – 8.50	10.02 –10.27
U. S. P. reagent, c'bys	10.52 –10.77	10.52 –10.77	10.52 –10.77
Boric, bbl., lb	.04¾– .05	.04¾– .05	.04¾– .05
Citric, kegs, lb	.28 – .31	.28 – .31	.28 – .31
Formic, bbl., lb	.11 – .11½	.11 – .11½	.11 – .11½
Gallic, tech., bbl., lb	.60 – .65	.60 – .65	.60 – .65
Hydrofluoric 30% carb., lb	.07 – .07½	.07 – .07½	.07 – .07½
Latic, 44%, tech., light, bbl., lb	.12 – .12½	.12 – .12½	.11½– .12
22%, tech., light, bbl., lb	.06½– .07	.06½– .07	.05½– .06
Muriatic, 18° tanks, cwt	1.00 – 1.10	1.00 – 1.10	1.00 – 1.10
Nitric, 36°, carboys, lb	.05 – .05½	.05 – .05½	.05 – .05½
Oleum, tanks, wks., ton	18.50 –20.00	18.50 –......	18.50 –20.00
Oxalic, crystals, bbl., lb	.11¾– .12⅛	.11¾– .12⅛	.11¾– .12⅛
Phosphoric, tech ., c'bys., lb	.09 – .10	.09 – .10	.09 – .10
Sulphuric, 60°, tanks, ton	11.00 –11.50	11.00 –11.50	11.00 –11.50
Sulphuric, 66°, tanks, ton	15.50 –......	15.50 –......	15.50 –......
Tannic, tech., bbl., lb	.23 – .35	.23 – .35	.23 – .35
Tartaric, powd., bbl., lb	.24 – .25	.24 – .25	.25½– .26
Tungstic, bbl , lb	1.40 – 1.50	1.40 – 1.50	1.40 – 1.50
Alcohol Amyl	......–......	......–......	......–......
From Pentane, tanks, lb	.143–......	.143–......	.15 –......
Alcohol Butyl, tanks, lb	.12 –......	.12 –......	.095–......
Alcohol, Ethyl, 190 p'f., bbl., gal	4.15½–......	4.15½–......	4.15½–......
Denatured, 190 proof			
No. 1 special, dr., gal	.346–......	.346–......	.346–......
No. 5, 188 proof, dr., gal	.34 –......	.34 –......	.34 –......
Alum, ammonia, lump, bbl., lb	.03 – .04	.03 – .04	.03 – .04
Chrome, bbl., lb	.04½– .05	.04½– .05	.04½– .05
Potash, lump, bbl., lb	.03 – .04	.03 – .04	.03 – .04
Aluminum sulphate, com., bags cwt	1.35 – 1.50	1.35 – 1.50	1.35 – 1.50
Iron free, bg., cwt	1.90 – 2.00	1.90 – 2.00	1.90 – 2.00
Aqua ammonia, 26°, drums lb	.02½– .03	.02½– .03	.02½– .03
tanks, lb	.02½– .02¾	.02½– .02¾	.02½– .02¾
Ammonia, anhydrous, cyl., lb	.15½– .16	.15½– .16	.15½– .16
tanks, lb	.04½–......	.04½–......	.05 –......
Ammonium carbonate, powd tech., casks, lb	.08 – .12	.08 – .12	.08 – .12
Sulphate, wks., cwt	1.20 –......	1.20 –......	.125–......
Amylacetate tech., tanks, lb	.142–......	.142–......	.145–......
Antimony Oxide, bbl., lb	.10¾– .12	.10½– .10¾	.08½– .10
Arsenic, white, powd., bbl., lb	.03½– .04	.03½– .04	.04 – .04½
Red, powd., kegs, lb	.15¾– .16	.15¾– .16	.14 – .15
Barium carbonate, bbl., ton	56.50 –58.00	56.50 –58.00	56.50 –58.00
Chloride, bbl., ton	74.00 –75.00	74.00 –75.00	61.50 –63.50
Nitrate, cask, lb	.08½– .09	.08½– .09	.08½– .09
Blanc fixe, dry, bbl., lb	.03½– .04	.03½– .04	.03½– .04
Bleaching powder, f.o.b., wks drums, cwt	1.90 – 2.00	1.90 – 2.00	1.85 – 2.00
Borax, grain, bags, ton	40.00 –45.00	40.00 –45.00	40.00 –45.00
Bromine, cs., lb	.36 – .38	.36 – .38	.36 – .38
Calcium acetate, bags	2.00 –......	2.00 –......	3.00 –......
Arsenate, dr., lb	.06 – .07	.06 – .07	.07 – .08
Carbide drums, lb	.05 – .06	.05 – .06	.05 – .06
Chloride, fused, dr., del., ton	20.00 –33.00	17.50 –......	17.50 –......
flake, dr., del., ton	22.00 –35.00	19.50 –......	19.50 –......
Phosphate, bbl., lb	.07½– .08	.07½– .08	.07½– .08
Carbon bisulphide, drums, lb	.05½– .08½	.05½– .06	.05½– .06
Tetrachloride drums, lb	.05¾– .08½	.05¾– .06	.05½– .06
Chlorine, liquid, tanks, wks., lb	2.00 –......	2.00 –......	.0185–......
Cylinders	.05½– .06	.05½– .06	.05½– .06
Cobalt oxide, cans, lb	1.25 – 1.30	1.25 – 1.30	1.35 – 1.40

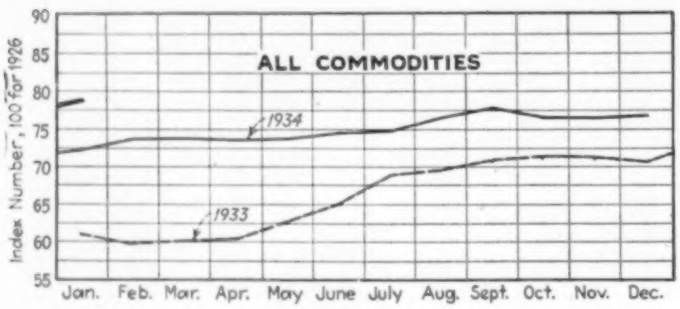
	Current Price	Last Month	Last Year
Copperas, bgs., f.o.b. wks., ton	14.00 –15.00	14.00 –15.00	14.00 –15.00
Copper carbonate, bbl., lb	.08½– .16	.08½– .16	.08½– .16
Cyanide, tech., bbl., lb	.37 – .38	.37 – .38	.39 – .40
Sulphate, bbl., cwt	3.85 – 4.00	3.85 – 4.00	3.75 – 4.00
Cream of tartar, bbl., lb	.16⅛ .17	.16½– .17	.18 – .19
Diethylene glycol, dr., lb	.14 – .16	.14 – .16	.14 – .16
Epsom salt, dom., tech., bbl., cwt	2.10 – 2.15	2.10 – 2.15	2.10 – 2.15
Imp., tech., bags, cwt	2.00 – 2.10	2.00 – 2.10	2.00 – 2.10
Ethyl acetate, drums, lb	.08½–......	.08½–......	.08½–......
Formaldehyde, 40%, bbl., lb	.06 – .07	.06 – .07	.06 – .07
Furfural, dr., contract, lb	.10 – .17½	.10 – .17½	.10 – .17½
Fusel oil, crude, drums, gal	.75 –......	.75 –......	.75 –......
Refined, dr., gal	1.25 – 1.30	1.25 – 1.30	1.25 – 1.30
Glaubers salt, bags, cwt	1.00 – 1.10	1.00 – 1.10	1.00 – 1.10
Glycerine, c.p., drums, extra, lb	.14 – .14½	.14 – .14½	.12 – .12½
Lead:			
White, basic carbonate, dry casks, lb	.06½–......	.06½–......	.06½–......
White, basic sulphate, sck., lb	.06 –......	.06 –......	.06 –......
Red, dry, sck., lb	.06 –......	.06 –......	.07¾–......
Lead acetate, white crys., bbl., lb	.10½– .11	.10½– .11	.10½– .11
Lead arsenate, powd., bbl., lb	.09 – .10	.09 – .10	.10 – .11
Lime, chem., bulk, ton	8.50 –......	8.50 –......	8.50 –......
Litharge, pwd., csk, lb	.05 –......	.05 –......	.06¾–......
Lithophone, bags, lb	.04½– .05	.04½– .05	.04½– .05
Magnesium carb., tech., bags, lb	.06 – .06½	.06 – .06½	.06– .06½
Methanol, 95%, tanks, gal	.33 –......	.33 –......	.33 –......
97%, tanks, gal	.34 –......	.34 –......	.34 –......
Synthetic, tanks, gal	.35½–......	.35½–......	.35½–......
Nickel salt, double, bbl., lb	.12½– .13	.12½– .13	.12 – .13
Orange mineral, csk., lb	.09 –......	.09 –......	.10¾–......
Phosphorus, red, cases, lb	.44 – .45	.44 – .45	.45 – .46
Yellow, cases, lb	.28 – .32	.28 – .32	.28 – .32
Potassium bichromate, casks, lb	.07¾– .08½	.07¾– .08½	.07¾– .08½
Carbonate, 80-85%, calc. csk., lb	.07 – .07¾	.07 – .07¾	.07 – .07¾
Chlorate, powd., lb	.09½– .10	.09½– .10	.09 – .09½
Hydroxide (c'stic potash) dr., lb	.06½– .06½	.06½– .06½	.07½– .08
Muriate, 80% bgs., ton	22.00 –......	22.00 –......	37.15 –......
Nitrate, bbl., lb	.05½– .06	.05½– .06	.05½– .06
Permanganate, drums, lb	.18½– .19	.18½– .19	.18½– .19
Prussiate, yellow, casks, lb	.18 – .19	.18 – .19	.18 – .19
Sal ammoniac, white, casks, lb	.04½– .05	.04½– .05	.04½– .05
Salsoda, bbl., cwt	1.00 – 1.05	1.00 – 1.05	1.00 – 1.05
Salt cake, bulk, ton	13.00 –15.00	13.00 –15.00	13.00 –15.00
Soda ash, light, 58%, bags, contract, cwt	1.23 –......	1.23 –......	1.23 –......
Dense, bags, cwt	1.25 –......	1.25 –......	1.25 –......
Soda, caustic, 76%, solid, drums, contract, cwt	2.60 – 3.00	2.60 – 3.00	2.60 – 3.00
Acetate, works, bbl., lb	.04½– .05	.04½– .05	.04½– .05
Bicarbonate, bbl., cwt	1.85 – 2.00	1.85 – 2.00	1.85 – 2.00
Bichromate, casks, lb	.05¾– .06⅛	.05¾– .06⅛	.05¾– .06⅛
Bisulphate, bulk, ton	14.00 –16.00	14.00 –16.00	14.00 –16.00
Bisulphite, bbl., lb	.03 – .04	.03 – .04	.03 – .04
Chlorate, kegs, lb	.06½– .06½	.06½– .06½	.06½– .06½
Chloride, tech., ton	12.00 –14.75	12.00 –14.75	12.00 –14.75
Cyanide, cases, dom., lb	.15½– .16	.15½– .16	.15½– .16
Fluoride, bbl., lb	.07½– .08	.07½– .08	.07½– .08
Hyposulphite, bbl., lb	2.40 – 2.50	2.40 – 2.50	2.40 – 2.50
Metasilicate, bbl., cwt	3.25 – 3.40	3.25 – 3.40	3.25 – 3.40
Nitrate, bags, cwt	1.275–......	1.24 –......	1.35 –......
Nitrite, casks, lb	.07½– .08	.07½– .08	.07½– .08
Phosphate, dibasic, bbl., lb	.022– .024	.022– 0.24	.021– .023
Prussiate, yel. drums, lb	.11½– .12	.11½– .12	.11½– .02
Silicate (40° dr.) wks cwt	.80 – .85	.80 – .85	.80 – .85
Sulphide, fused, 60-62%, dr., lb	.02¾– .03½	.02¾– .03	.02¾– .03
Sulphite, crys., bbl., lb	.02½– .02¾	.02½ .02¾	.03 – .03
Sulphur, crude at mine, bulk, ton	18.00 –......	18.00 –......	18.00 –......
Chloride, dr., lb	.03½– .04	.03½– .04	.03½– .04
Dioxide, cyl., lb	.07 – .07½	.07 – .07½	.07 – .07½
Flour, bag, cwt	1.60 – 3.00	1.60 – 3.00	1.55 – 3.00
Tin Oxide, bbl. lb	.52 –......	.56 –......	.55 –......
Crystals, bbl., lb	.36 –......	.38 –......	.38½–......
Zinc chloride, gran., bbl., lb	.05½– .06	.05½– .06	.05½– .06
Carbonate, bbl., lb	.09½– .11	.09½– .11	.09½– .11
Cyanide, dr., lb	.38 – .42	.38 – .42	.38 – .42
Dust, bbl., lb	.057– .07	.057– .07	.07 – .07½
Zinc oxide, lead free, bag, lb	.05½–......	.05½–......	.06½–......
5% lead sulphate, bags, lb	.05½–......	.05½–......	.06½–......
Sulphate, bbl., cwt	2.75 – 3.00	2.75 – 3.00	3.00 – 3.25

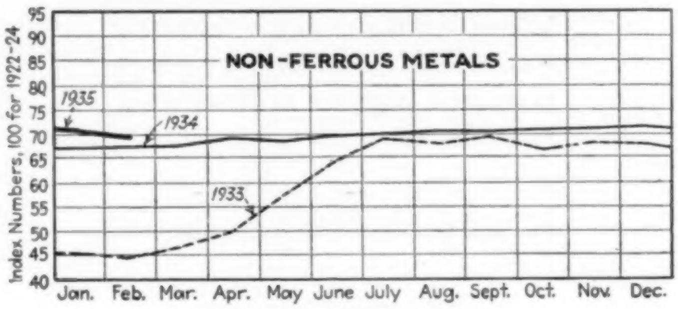
Oils and Fats

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb	$0.09¾–$0.10	$0.09¾–$0.10	$0.09¾–$0.10
Chinawood oil, bbl., lb	.12 –......	.09¾–......	.08 –......
Coconut oil, Ceylon, tanks, N. Y. lb	.06½–......	.05⅛–......	.02¾–......
Corn oil crude, tanks, (f.o.b. mill), lb	.11 –......	.10½–......	.04¾–......
Cottonseed oil, crude (f.o.b. mill), tanks, lb	.10½–......	.09¾–......	.04¼–......
Linseed oil, raw car lots, bbl., lb	.095–......	.091–......	.093–......
Palm, casks, lb	.05¾–......	.04¾–......	.03¾–......
Palm Kernel, bbl., lb	nom.	nom.	.04¼–......
Peanut oil, crude, tanks (mill), lb	.10¼–......	.10½–......	.04¾–......
Rapeseed oil, refined, bbl., gal	.50 – .52	.47 – .48	.44 – .45
Soya bean, tank, lb	.10 –......	.08½–......	.06½–......
Sulphur (olive foots), bbl., lb	.08⅛–......	.08 –......	.06½–......
Cod, Newfoundland, bbl., gal	.36 –......	.36 –......	.35 –
Menhaden, light pressed, bbl., lb	.065–......	.06 –......	.051–......
Crude, tanks (f.o.b. factory), gal	.30 –......	.28 –......	.15 –......
Grease, yellow, loose, lb	.06½–......	.05½–......	.03½–......
Oleo stearine, lb	.12 –......	.10¼–......	.05⅝–......
Red oil, distilled, d.p. bbl., lb	.08½–......	.07¾–......	.07 –......
Tallow, extra, loose, lb	.07 –......	.06 –......	.03½–......









Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl., lb	\$0.60 –\$0.65	\$0.60 –\$0.65	\$0.60 –\$0.62
Refined, bbl., lb	.80 – .85	.80 – .85	.80 – .85
Alpha-naphthylamine, bbl., lb	.32 – .34	.32 – .34	.32 – .34
Aniline oil, drums, extra, lb	.14½– .15	.14½– .15	.14½– .15
Aniline salts, bbl., lb	.24 – .25	.24 – .25	.24 – .52
Benzaldehyde, U.S.P., dr., lb	1.10 – 1.25	1.10 – 1.25	1.10 – 1.25
Benzidine base, bbl., lb	.65 – .67	.65 – .67	.65 – .67
Benzoic acid, U.S.P., kgs, lb	.48 – .52	.48 – .52	.48 – .52
Benzyl chloride, tech., dr., lb	.30 – .35	.30 – .35	.30 – .35
Benzol, 90% tanks, works, gal.	.15 – .16	.15 – .16	.20½– .21
Beta-naphthol, tech., drums, lb.	.22 – .24	.22 – .24	.22 – .24
Cresol, U. S. P., dr., lb	.11 – .11½	.11 – .11½	.11– .11½
Cresylic acid, 97%, dr., wks., gal	.42 – .43	.42 – .43	.50 – .51
Diethylaniline, dr., lb	.55 – .58	.55 – .58	.55 – .58
Dinitrophenol, bbl., lb	.29 – .30	.29 – .30	.29 – .30
Dinitrotoluen, bbl. lb	.16 – .17	.16 – .17	.16 – .17
Dip oil 25% dr., gal	.23 – .25	.23 – .25	.23 – .25
Diphenylamine, bbl., lb	.38 – .40	.38 – .40	.38 – .40
H-acid, bbl., lb	.65 – .70	.65 – .70	.65 – .70
Naphthalene, flake, bbl., lb	.05½– .06½	.05½– .06½	.06 – .07
Nitrobenzene, dr., lb	.08½– .09	.08½– .09	.08½– .10
Para-nitraniline, bbl., lb	.51 – .55	.51 – .55	.51 – .55
Phenol, U.S.P., drums, lb	.14½– .15	.14½– .15	.14½– .15
Picric acid, bbl., lb	.30 – .40	.30 – .40	.30 – .40
Pyridine, dr., gal	1.10 – 1.15	1.10 – 1.15	.90 – .95
Resorcinal, tech., kegs, lb	.65 – .70	.65 – .70	.65 – .70
Salicylic acid, tech., bbl., lb	.40 – .42	.40 – .42	.40 – .42
Solvent naphtha, w.w., tanks, gal	.26 –......	.26 –......	.26 –......
Tolidine, bbl., lb	.88 – .90	.88 – .90	.88 – .90
Toluene, tanks, works, gal	.30 –......	.30 –......	.30 –......
Xylene, com., tanks, gal	.26 –......	.26 –......	.26 –. . .

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton	\$22.00–\$25.00	\$22.00–\$25.00	\$22.00–\$25.00
Casein, tech., bbl., lb	.13 – .14	.11 – .12	.12 – .13
China clay, dom., f.o.b mine, ton	8.00 –20.00	8.00 –20.00	8.00 –20.00
Dry colors:			
Carbon gas, black (wks.), lb	.04 – .20	.04 – .20	.04 – .20
Prussian blue, bbl., lb	.35½– .37	.35½– .37	.35 – .36
Ultramine blue, bbl., lb	.06 – .32	.06 – .32	.06 – .32
Chrome green, bbl., lb	.26 – .27	.26 – .27	.26 – .27
Carmine red, tins, lb	4.00 – 4.40	4.00 – 4.40	3.65 – 3.75
Para toner, lb	.80 – .85	.80 – .85	.75 – .80
Vermilion, English, bbl., lb	1.56 – 1.58	1.56 – 1.58	1.58 – 1.60
Chrome yellow, C. P., bbl., lb.	.15 – .16	.15 – .15½	.15 – .15½
Feldspar, No. 1 (f.o.b. N.C.), ton	6.50 – 7.50	6.50 – 7.50	6.50 – 7.50
Graphite, Ceylon, lump, bbl., lb.	.07 – .08½	.07 – .08½	.07 – .08½
Gum copal Congo, bags, lb	.09 – .10	.09 – .10	.06 – .08
Manila, bags, lb	.09 – .10	.09 – .10	.16 – .17
Damar, Batavia, cases, lb	.15½– .16	.15½– .16	.16 – .16½
Kauri No. 1 cases, lb	.20 – .25	.20 – .25	.45 – .48
Kieselguhr (f.o.b. N.Y.), ton	50.00 –55.00	50.00 –55.00	50.00 –55.00
Magnesite, calc, ton	50.00 –......	50.00 –......	40.00 –......
Pumice stone, lump, bbl., lb	.05 – .07	.05 – .08	.05 – .07
Imported, casks, lb	.03 – .40	.03 – .40	.03 – .35
Rosin, H., bbl	5.95 –......	5.95 –......	6.45 –......
Turpentine, gal	.55½–......	.55½–......	.62 –......
Shellac, orange, fine, bags, lb	.27 –......	.31 –......	.26 – .27
Bleached, bonedry, bags, lb	.21 – .22	.24 – .30	.29 – .31
T. N. bags, lb	.14 – .16	.18 – .21	.21 – .22
Soapstone (f.o.b. Vt.), bags, ton	10.00 –12.00	10.00 –12.00	10.00 –12.00
Talc, 200 mesh (f.o.b. Vt.), ton	8.00 – 8.50	8.00 – 8.50	8.00 – 8.50
300 mesh (f.o.b Ga.), ton	7.50 –10.00	7.50 –10.00	7.50 –11.00
225 mesh (f.o.b. N. Y.), ton	13.75 –....	13.75 –.....	13.75 –.....

INDUSTRIAL NOTES

HOMESTEAD VALVE M'F'G. CO., Coraopolis, Pa., announces the following new representatives: Carey Machinery & Supply Co., 119 E. Lombard St., Baltimore; L. E. Livingstone, 2012 Ward Parkway, Fort Worth, Texas; Chas. A. Randorf, 83 Delham Ave., Buffalo, N. Y.; and Atkins, Kroll & Co., 260 California St., San Francisco, as exclusive representative in the Philippine Islands.

SPROUT, WALDRON & CO., INC., Muncy, Pa., has appointed the Conite Engineering and Sales Co., Nashville, as sales agents for Tennessee, parts of Kentucky and Alabama.

MATHIESON ALKALI WORKS, INC., New York, has opened an office in the Second National Bank Bldg., Houston, Texas, which will be district sales headquarters for the Southwest. The office is in charge of W. Scott Hammond.

WORTHINGTON PUMP AND MACHINERY CORP., Harrison, N. J., has consolidated several of its contributing sales divisions into one mining and construction department under the management of W. A. Neill.

PRODUCTIVE EQUIPMENT CORP., Chicago, has appointed the following representatives: A. H. Young, Leader Bldg., Cleveland; A. E. Fielding and Sam Wettlaufer, operating as the Screen Equipment Co., 9 Lafayette Ave., Buffalo; and the Wisconsin Foundry & Machine Co., Madison, Wisc.

WILSON & BENNETT MFG. CO., Chicago, has placed James H. Brown, 1039 W. Woodruff St., Toledo, in charge of its sales in that city.

THE OHIO FORGE AND MACHINE CORP., Cleveland, successors to Gears & Forgings, Inc., has appointed the Denton and Anderson Co. as its representatives in the Chicago territory.

ALLIS-CHALMERS MFG. CO., Milwaukee, has moved its Pittsburgh office to the Koppers B'l'd'g. Guy V. Woody is manager of the office.

APEX CHEMICAL CO., of Ohio with factory and offices at Nitro, W. Va., has changed its name to Ohio-Apex, Inc.

THE CALCO CHEMICAL CO., INC., Bound Brook, N. J., has moved its southern headquarters to 1112 South Boulevard, Charlotte, N. C. A modern laboratory has been installed. John L. Crist, a graduate in chemical engineering is in charge of the headquarters.

SOLVAY SALES CORP., New York, on April 1 will move general sales offices from 61 Broadway to 40 Rector St.

New CONSTRUCTION

Where Plants Are Being Built in Process Industries

	Current Projects: Proposed Work and Bids	Current Projects: Contracts Awarded	Cumulative 1935: Proposed Work and Bids	Cumulative 1935: Contracts Awarded
New England	$400,000	....	$486,000	$75,000
Middle Atlantic	28,000	$404,000	557,000	355,000
South	230,000	58,000	1,179,000	442,000
Middle West	1,459,000	35,000	2,094,000	831,000
West of Mississippi	440,000	....	468,000	656,000
Far West	847,000	28,000	1,203,000	28,000
Canada	1,455,000	40,000	3,547,000	70,000
Total	$4,859,000	$565,000	$9,534,000	$2,457,000

PROPOSED WORK BIDS ASKED

Carbon Black Plant — United Carbon Co., Charleston, W. Va., and 350 5th Ave., New York, N. Y., has acquired properties in the Monroe and Richland oil and gas fields in Louisiana and plans additions and extensions to the carbon black plants and natural gas developments. Estimated cost to exceed $100,000.

Chemical Laboratory—Trinity College, Hartford, Conn., will soon award the contract for the construction of a 3 story chemical laboratory. McKim, Mead & White, 101 Park Ave., New York, N. Y., Archts. Estimated cost $400,000.

China Factory—Sterling China Co., Wellsville, O., plans to construct two new tunnel kilns; office building and sample room, 45x110 ft. clay shop, kiln shed, glost warehouse and bisque warehouse. Estimated cost $175,000.

Coke By-Products Plant — Michigan By-Products Coke Co., L. C. Lillie, Grand Haven, Mich., contemplates the construction of a coke by-products plant at Grand Haven. Estimated cost $1,000,000 or more.

Distillery—Bear Creek Vineyards, Stockton, Calif., contemplate the construction of a distillery to include storage and distribution buildings. Estimated cost $60,000.

Distillery—Commercial Solvents Co., 629 Cherry St., Terre Haute, Ind., plans to construct an addition to its distilling plant. Estimated cost $29,110.

Distillery—Co-operative Assn., c/o S. D. San Fillippo, Lincoln Ave., San Jose, Calif., plans to construct a distillery here. Estimated cost $30,000.

Distillery—Kennebec Distillery Co., Frankfort, Ky., is having plans prepared by C. J. Kiefer, Archt. and Engr., Schmidt Bldg., Cincinnati, O., for a distillery. Estimated cost $100,000.

Distillery—Wyoming Distilling Co., c/o J. E. Scott, Casper, Wyo., is having plans prepared for the construction of a distillery. Estimated cost $150,000.

Enameling Plant—Ferro Enamel Corp., c/o A. Fowler, Engr., 4150 East 56th St., Cleveland, O., is receiving bids for the construction of a 1 story, 46x52 ft. furnace building at its plant. Estimated cost $25,000.

Fertilizer Plant—Lyons Fertilizer Co., Tampa, Fla., contemplates the construction of a fertilizer plant here. Maturity indefinite. Estimated cost $30,000.

Glass Factory—Libbey-Owens-Ford Glass Co., Rossford, O., plans to modernize its plant here. Maturity indefinite. Estimated cost $150,000.

Paint and Glass Factory—W. P. Fuller Co., 301 Mission St., San Francisco, Calif., has purchased the assembly plant formerly occupied by the Ford Motor Co., at Seattle, Wash., and will alter and equip same for a paint and glass factory. Estimated cost $28,000.

Medicine Factory—The Mid West Chemicals, Ltd., S. Richard Pooley, Pres., North Battleford, Sask., Can., manufacturer of pharmaceutical and medicinal preparations, plans the construction of a factory. Estimated cost $100,000.

Mines and Laboratory Building—University of Minnesota, Minneapolis, Minn., plans the construction of a mines and laboratory building at Hibbing, Minn. Estimated cost $250,000.

Peat Fuel Plant—British Syndicate, c/o I. P. Nolan, Mayor, Ottawa, Ont., Can., plans the construction of a peat fuel plant to have an annual capacity of 50,000 tons at Afred, Ont. Estimated cost $900,000.

Pulp Mill—Annapolis Basin Pulp & Power Co., Ltd., K. L. Crowell, Mgr., Bridgetown, N. S., Can., plans the construction of a pulp mill and electrical power development at Paradise Lake.

Refinery—Associated Oil Co., 79 New Montgomery St., San Francisco, Calif., and c/o Tidewater Oil Co., 17 Battery Pl., New York, N. Y., plans alterations and additions to its refineries at Avon and Watson, Calif. Estimated cost to exceed $500,000.

Oil Refinery—Buffalo-Phenix Corp., 800 West Ferry St., Buffalo, N. Y., plans the installation of air and water pressure plants to force recovery of crude oil from 300 oil wells in old Bessemer Pool, Lawrence Co., Pa. Darwin R. Martin, Vice Pres.

Oil Refinery—Great West Refining Co., Ltd., Yorkton, Sask., Can., plans the construction of a complete refining plant here.

Oil Refinery — Marmac Oil Co., Ltd., H. Edward Swift, Pres., Winnipeg, Man., Can., contemplates the construction of an oil refinery. Estimated cost $50,000.

Oil Refinery — Riverside Oil Co., Ltd., Montreal, Que., Can., plans to construct a small refinery. Estimated cost $49,000.

Oil Refinery—Royalite Oil Co., Ltd., J. H. McLeod, Mgr., Calgary, Alta., Can., plans to construct an absorption plant in the Spring, at Turner Valley. Estimated cost $200,000.

Oil Refinery—Standard Oil Co. of California, 225 Bush St., San Francisco, Calif., plans to reconstruct the pressure stills at its Richmond Refinery. Estimated cost exceeds $200,000.

Gasoline Cracking Plant—Wilshire Oil Co., 2455 East 27th St., Vernon, Calif., plans the construction of a free distillation, refining unit to have a daily capacity of 12,500 bbl. attached to a Dubbs cracking plant unit of 7,800 bbl. daily capacity, at Leffingwell St. and Shoemaker Rd., Santa Fe Springs, Calif. Estimated cost $28,500.

Pottery Plant—Robinson-Ransbottom Pottery Co., Roseville, O., plans improvements to its plant during the year to include new tunnel kiln and modern machinery and equipment. Estimated cost between $80,000 and $100,000.

Rock Wool Plant — Canadian Johns-Manville Co., Ltd., 904 St. James St., W., Montreal, Que., Can., plans to construct a rock wool plant at Asbestos, Que. Estimated cost $100,000.

Roofing Plant—Emeralite Surface Products Co., Ely, Minn., plans repairs and alterations to its roofing manufacturing plant at Ely. Estimated cost $40,000.

Soap Factory—Procter & Gamble Co., Ivorydale, Cincinnati, O., has acquired the plant of the Philippine Mfg. Co., Manila, P. I., and plans to improve same for its own use. Estimated cost exceeds $30,000.

CONTRACTS AWARDED

Cyanamid Plant — American Cyanamid & Chemical Co., Bridgeville, Pa., will build a 1 story, 80x95 ft. addition to its plant. Separate contracts are now being awarded. Estimated cost exceeds $28,900 with equipment.

Distillery — Kentucky Valley Distilling Co., Commercial Bldg., Louisville, Ky., awarded contract for distillery at Chapeze, Ky., to H. G. Whittenberg, 3133 South 3rd St., Louisville. Estimated cost exceeds $28,000.

Distillery—National Distillers Products Corp., Frankfort, Ky., and 120 Bway., New York, N. Y., are awarding general and separate contracts for reconditioning and modernizing the distillery of W. A. Gaines at Frankfort, Ky., which they recently acquired. Estimated cost to exceed $30,000.

Distillery—North American Warehousing Co., Mifflin and Vandalia Sts., Philadelphia, Pa., awarded contract for installation of steel and timber barrel racks at its distilling plant to S. H. Levin, 1619 Sansom St., Philadelphia. Estimated cost $100,000.

Gas Plant—Public Service Electric & Gas Co., Camden, N. J., awarded contract for an addition to its gas plant including a battery of by-product coke ovens, to Koppers Construction Co., Koppers Bldg., Pittsburgh, Pa. Estimated cost $40,000.

Oil Refinery—Consumers Refineries Co-operative Assn., Regina, Sask., Can., awarded contract for refinery to North West Iron Works, Regina. Estimated cost $40,000.

Oil Refinery—United Refining Co., H. A. Logan, Pres., Box 780, Warren, Pa., plans improvements to double the gasoline output at its plant. Contract for Dubbs cracking unit has been awarded to the Universal Oil Products Co., 110 South Michigan Ave., Chicago; for flash chamber and tower to Struthers-Wells-Titusville Corp., Warren, Pa. Company will erect buildings by day labor. Universal Oil Products Co., 110 South Michigan Ave., Chicago, Engr. Estimated cost exceeds $28,000.

Platinum Factory—American Platinum Works, 231 Railroad Ave., Newark, N. J., awarded contract for 2 story addition to its plant to E. M. Waldron, Inc., 40 Park Pl., Newark. Estimated cost $30,000.

Pulp Mill—The Weyerhaeuser Timber Co., F. R. Titcomb, Mgr., Everett, Wash., has started work on the construction of a 150 ton unbleached pulp mill in Everett. The new plant will manufacture sulphite pulp from hemlock logs brought from the company's logging operations near Olympia.

Roofing Products Factory—R. J. Scott & Co., 90 Broad St., New York, N. Y., manufacturer of roofing products, has acquired a plant and five acre tract of land at Middlesex Ave. and Lehigh Valley R. R., Metuchen, N. J., and will alter and recondition the factory for its own use. Work will be done by day labor and separate contracts. Estimated cost exceeds $28,000.

Varnish Factory—Forbes Varnish Co., C. H. Read, Pres., 3800 West 143rd St., Cleveland, O., awarded contract for addition to its factory to Alger & Knowlton, 2138 Lee Rd., Cleveland. Estimated cost $35,000.

Warehouse—American Medicinal Spirits Co., Russell and Alluvion Sts., Baltimore, Md., is building a 4 story, 83x115 ft. warehouse. Sanderson & Porter, Engrs., 52 William St., New York, N. Y., are taking sub-bids for superstructure. Foundation contract already awarded. Estimated cost $75,000.

Warehouse—Maryland Distilling Co., Relay, Md., awarded contract for 5 story warehouse at Hale Thorpe, Md., to Engineering Contracting Corp., 504½ St. Paul St., Baltimore. Estimated cost $75,000.

Chemical Industry Makes Substantial Recovery From Low of 1932

HOW HIGH did the chemical industry go in its peak year—which for many branches was 1929? How low did the industry go during the depression period? How much has the industry recovered from its depression-point low? The answer to these questions, perhaps, cannot be given with certainty but sufficient data are available—including production of specified chemicals, sales to consumers, and manufacturing activities in industries which are large consumers of chemicals—to give a fairly definite view of the varying status of the chemical industry as a whole over a period of years.

The accompanying graph offers a presentation of the fluctations in different branches of the chemical-producing and chemical-consuming industries for 1929 to 1934 inclusive with the average for the five-year period, 1923-27, representing normal or 100.

Alkalis, as shown by the movement of caustic soda and soda ash, followed the general trend and reached lows for recent years in 1932 but had recovered a good deal of the lost ground by 1934 and in each case entered the present year on a plane much higher than the 1923-1927 average. Sulphuric acid, however, influenced largely by the drop in the metallurgical fertilizer, and coal-tar industries was off sharply in 1932 and its present status is established at close to 9 per cent below the 1923-1927 average.

Data for pigments, including white lead, zinc oxide, and lithopone, are not available for 1934 although it is certain that production in each case made considerable progress last year. Both zinc oxide and lithopone are holding positions much higher than the 1923-27 average but white lead, due to competitive influences has fallen far below the position it occupied early in the decade.

The textile trade is one of the few which reversed the general trend by falling off in productive activity in 1934 as compared with 1933. A tapering off in silk consumption has been noted in recent years but the present rate still is slightly in excess of that for 1923-27.

In the case of vegetable oils, fish oils, and animal fats, the depression years failed to bring either group below the 1923-1927 average level. Interchangability of these products, however, has brought about considerable fluctuation within each group and in 1934, animal fats held the highest relative position based on the volume of factory consumption, due to the price advantage enjoyed throughout the greater part of the year.

Manufacture of plate glass entered the new year about 15 per cent below average with a decided pick-up from the low of 1932 because of enlarged demand from the automotive trade.

Slow recovery in building and mining has held explosives down to a present rating about 76 per cent of normal. On the other hand, petroleum refining is 25 per cent above the 1923-27 average and in its low point in 1932 was nearly 15 per cent above the five-year average.